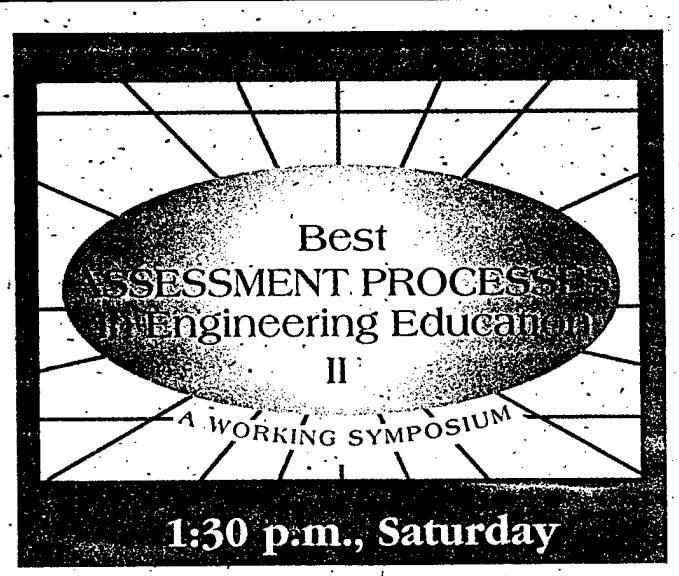
Saturday, 1:30 p.m.



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INSTITUTE OF TECHNOLOGY

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14. ABSTRACT
One of the USAF Academy's educational outcomes is to produce ▒ officers who can frame and resolve ill-defined problems. The purpose of constructing ill-defined assessment tasks for our students is to assess their ability to recognize and contribute to the resolution of real world dilemmas they are likely to face in their future careers as Air Force Officers.

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General Criteria to Evaluate Ill-defined Problem Solutions

One of the USAF Academy's educational outcomes is to produce "officers who can frame and resolve ill-defined problems. The purpose of constructing ill-defined assessment tasks for our students is to assess the their ability to recognize and contribute to the resolution of real world dilemmas they are likely to face in their future careers as Air Force officers. Our first step was to define "ill-defined" problems:

Definition

Ill-defined problems are ambiguous, interactive and ever-changing. Framing means constructing a working model and revising it based on feedback. Resolving means that an ill-defined problem is never solved for good- rather it is solved again and again (re-solved) as the problem is framed again and again; and, each successive solution is more refined (resolution).

In assessing student skills in this area, it is important to recognize that the problem should be "ill-defined" from the student's perspective, not necessarily "ill-defined" from the perspective of experts in the field or even the faculty member evaluating performance. This suggests that different types of problems will be appropriate for assessing students general ability and their abilities within their chosen academic specialty.

It is also important to point out that it is *the solution process* that must be assessed, not just the solution. In fact, a student who had already learned "the approved solution" from independent reading, might be less likely to demonstrate a high level of framing or resolving skills.

In addition to the definitions contained in the outcome itself, it is important to point out that ill-defined problems have no single absolute solutions. However, solutions to these problems are more than a matter of opinion or preference; viable criteria exist for evaluating solution quality.

Ill-defined problems frequently contain extraneous information may also lack some necessary data. To provide meaningful assessment, tasks to evaluate students' skills must be carefully tailored to challenge students but not overwhelm them. Assessment of both individual and group ability to frame and resolving ill-defined problems should be undertaken across all four academic years.

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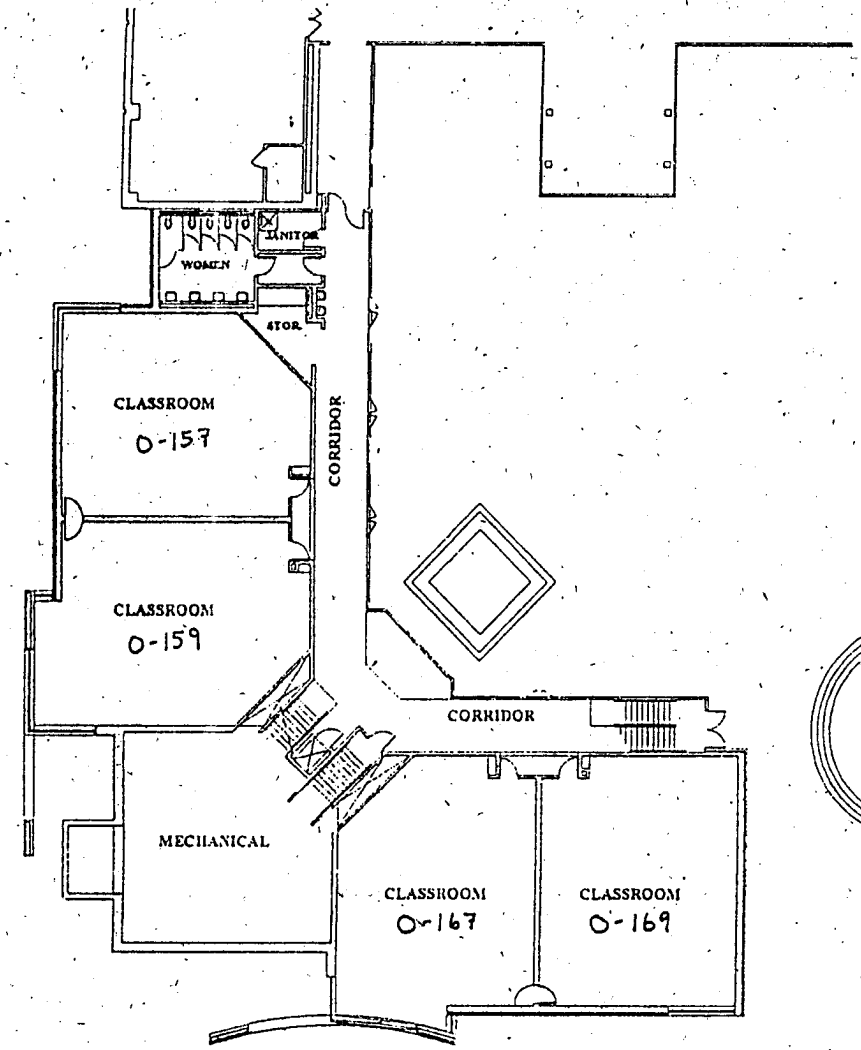
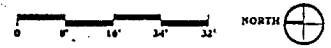
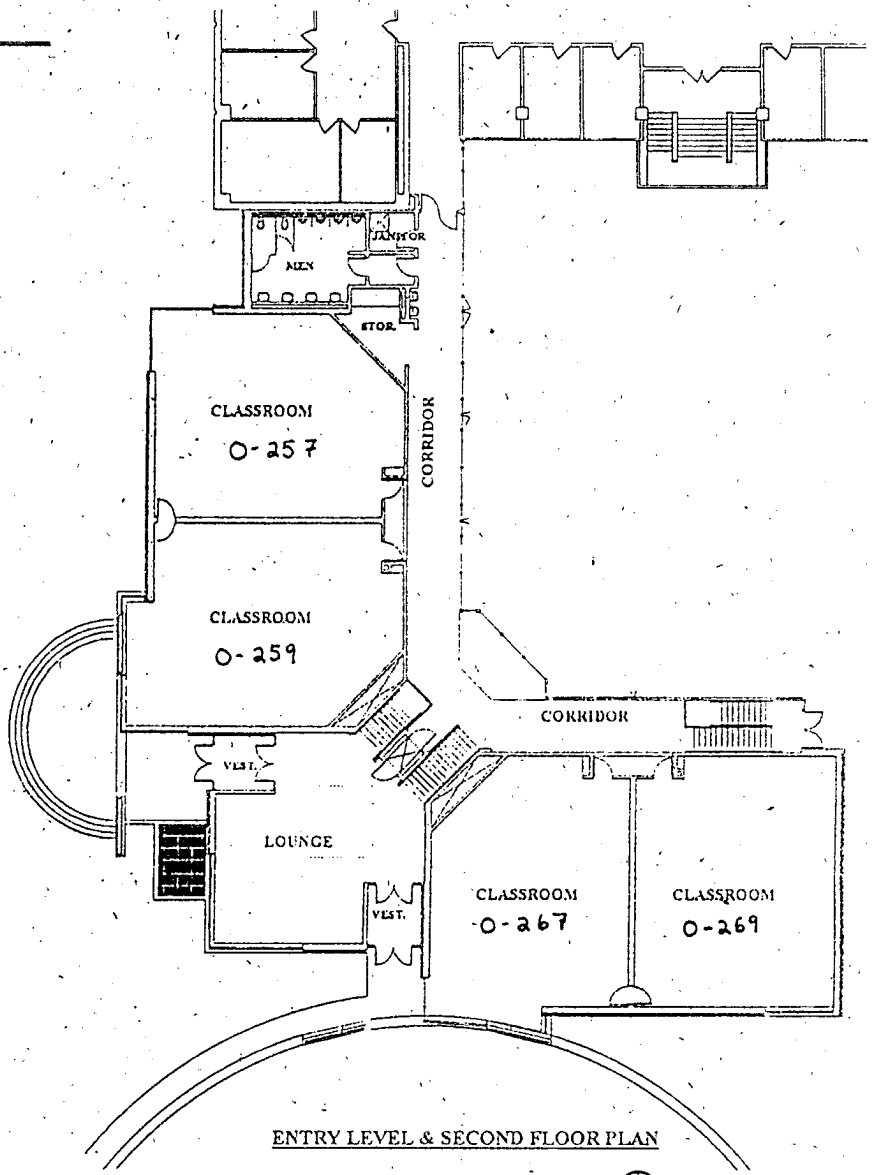
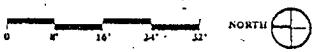


LOWER LEVEL & GROUND FLOOR PLAN





ENTRY LEVEL & SECOND FLOOR PLAN



OLIN HALL ADDITION

ROSE HULMAN INSTITUTE OF TECHNOLOGY

LEVELS OF PERFORMANCE

Framing and Resolving Ill-defined Problems

EXCELLENT

- identifies most important ill-defined aspects of problem as well as general "ill-defined" problem nature
- uses goal, mission or other ultimates to structure problem space
- keenly aware of personal perspective and bias and compensate effectively; also aware of larger contexts
- use general principles and fundamental concepts to frame overall problem space and as solution tools
- systematically works through problem; often makes multiple passes through the problem space as conditions change in order to assesses consequences of changes or alternatives
- unsuccessful attempts regularly used to better understand problem and solution process
- generates rich variety of alternatives, tests them objectively and selects rationally
- appropriate level of confidence and commitment to eventual solution

SATISFACTORY

- aware of general "ill-defined" nature of the problem and some of the specific problem deficiencies
- may structure problem space based on superficial problem characteristics or unwarranted assumptions
- somewhat aware of personal perspective; evidence of awareness found throughout solution process but some important connections to more general contexts not understood
- tendency to use particular tools and mechanisms appropriately but may lack ability to modify and adapt them appropriately due to incomplete understanding of underlying principles.
- works through problem systematically but may omit necessary reconsideration of assumptions
- unsuccessful attempts recognized and abandoned
- generates multiple potential solutions but may not fully consider all of them or use appropriate criteria to select
- likely, to lack confidence in solution; limited commitment without encouragement or support

DEFICIENT

- unaware of either general or specific characteristics that preclude routine solution procedures
- apparently unaware of personal perspective or bias; assumes single perspective is sufficient
- random or inappropriate application of tools; may not be able to provide reasons for approach selected
- unsuccessful, sporadic, apparently random, attempts at problem lead to frustration and abandonment
- unsuccessful attempts based on untenable assumptions not recognized.
- fully commits to first apparent solution path and follows it through to completion without reconsideration
- likely to display either no confidence in solution or process (may claim problem is impossible) or be inappropriately confident and overly committed to obviously ineffective solution

KC-135 Deployment Problem

SSAN _____

The commander has asked you to put together a maintenance support force for the deployment of three KC-135s to a temporary operating location. When we recently deployed three aircraft, our support force had 30 maintenance personnel and we were able to fly a total of 36 missions for the two days we were deployed. Two years ago, we took 16 personnel and five aircraft to Eglin AFB, FL where we flew 40 missions in the four days we were deployed. Our sister squadron just returned from a five day trip, where they flew ten missions in the five days they were deployed, using just five technicians and one aircraft.

The commander wants to fly 30 missions in the three days we are deployed. You plan a maintenance support force that includes 20 personnel.

How effective do you think we will be during the deployment, as measures against the commander's goal of 30 missions? **Support your position by describing how you arrived at your answer.**

Questions on page 2:

- On a scale of one to ten, how confident are you that your answer is correct?
- On what do you base your level of confidence?
- Does your answer depend on any particular assumptions? What are some of the important ones?
- If you could choose to have one more piece of information, what would that be?
- How would that additional information change your original answer?

You are assigned to make recommendations to the Head of the interplanetary exploration space mission group at NASA. The subject mission is to Mars in 12 years.

- Your range of options include: machine only, crewed, or a composite.
- You may examine a tradeoff for a rover or extra fuel for vehicle hopping.
- You may also examine a tradeoffs for the trajectory for the transfer orbit to go from Earth to Mars and back: direct, Hohmann, or OTB (one tangent burn).
- Your main concern once you decide on whether or not a crew should be on the space vehicle is as follows:
    1) Machine only Option--What instruments must be included? Should there be robots? Should there be a sample and return or on Mars processing only? Any other important questions you seem to think are important.
    2) Crewed Option--How many? Backgrounds? Age? Abilities? Gender? Personality type? International or US only? Any other important questions you seem to think are important.
    3) Composite Option--How many machines do you forgo to add people? Also all the above apply.

- In the past, only male crews went to the Moon. The crews consisted of two individuals in a lander and one remaining on the main vehicle.
- Mercury and Gemini programs started out with one and two individuals before progressing to three in the Apollo program.
- The SkyLab, Shuttle, and Mir programs included a varied crew depending on mission duration and objective.

What recommendation do you make for the mission? **Support your position by describing how you arrived at your answer.**

Questions on page 2:

- On a scale of one to ten, how confident are you that your answer is correct?

- On what do you base your level of confidence?

- Does your answer depend on any particular assumptions? What are some of the important ones?

- If you could choose to have one more piece of information, what would that be?

- How would that additional information change your original answer?

The following problem is purposely ill-defined, vague, and ambiguous. Insufficient as well as extraneous information may exist in the givens, and there may be several solutions at the outset that would have to be refined after obtaining more information. Our purpose here is to evaluate your ability to *frame* the problem, given only the information presented, and discuss assumptions, "free" parameters, possible solutions, and tradeoffs.

Background Information

Figures 1-4 depict graphical representations of the general magnitude specifications for the four common types of filters: lowpass, highpass, bandpass, and bandreject (notch). In this problem, you will be specifying a filter type (or types) and determining as many of the appropriate parameters as possible.

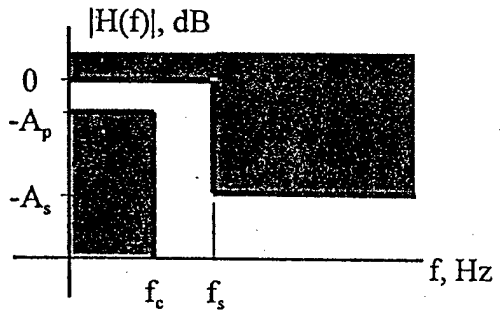


Figure 1. Low Pass Filter

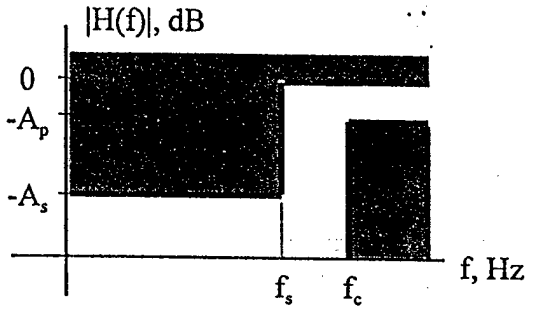


Figure 2. High Pass Filter

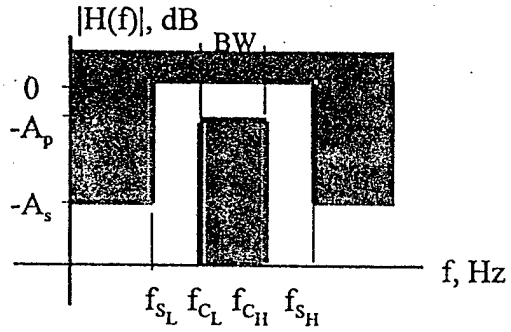


Figure 3. Band Pass Filter

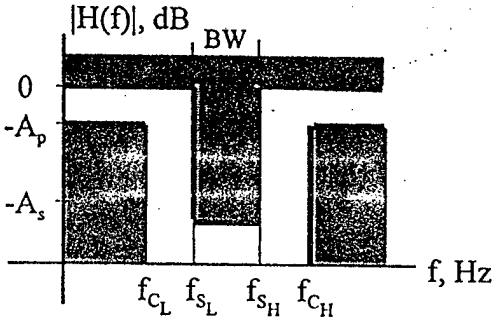


Figure 4. Band Reject Filter

where

A_p	$\Rightarrow$	the absolute value of the passband attenuation, in dB
A_s	$\Rightarrow$	the absolute value of the stopband attenuation, in dB
f_s	$\Rightarrow$	the lower end of the stop band
f_c	$\Rightarrow$	the cutoff frequency
f_{S_L}, f_{S_H}	$\Rightarrow$	stopband limits for bandpass or bandreject filters
f_{C_L}, f_{C_H}	$\Rightarrow$	passband limits for bandpass or bandreject filters
BW	$\Rightarrow$	bandwidth of bandpass of band reject filters

We are more interested in the *process* you go through than we are in a bunch of equations, so please give us all your thoughts as you go along.
Here's the problem:

You are a Lockheed electrical engineer working on a digital data transmission problem. You have asked an engineer at another location to specify the problem as clearly as possible by email so you can make a presentation to your boss by 3:00 p.m. this afternoon. Unknown to you, the engineer at the other end is wearing a Hawaiian shirt and is going to jump in the car and head for the airport as soon as he sends you the email. Unfortunately, nobody else is familiar with the problem he's having so you're stuck making the best of it in your presentation to the boss.

Here's the email:

Hi _____,

Thanks for taking a look at this. We have a coaxial line coming into the cockpit of the C-17 that carries a single TTL-compatible RPM signal to a receiver behind the cockpit instrumentation. Unfortunately, the coax is routed pretty close to a 400-Hz, AC generator that is playing heck with our signal. I've got a bandwidth on the digital signal of about 1 kHz to 50 kHz.

I asked them to reroute the coax and they said it can't be done without adding about $10K to the instrumentation package price. (I'm already in hot water as it is, and don't want to add any more expense than I have to!) I know you probably need to have a DC component figure, but our spectrum analyzer is broken and I really don't have time to get a worst case duty cycle on the digital signal because I'll be late for my plane to Hawaii! So, is there some kind of a cheap filter or something we can use?

Thanks again. Good luck!

Your ex-friend, Bob

P.S. I'll bring you back a can of macadamia nuts.

Your Task

For your presentation to the boss, sketch a filter specification (or specifications) and identify as many parameters as you can of those given on the previous page. Discuss with your boss any "free" parameters, as you see them, and how you could choose those parameters to optimize cost, performance, etc. Specify all assumptions you must make for each choice of solution. Tell the boss what information you would really need to completely specify the filter (or filters). Good luck!

Questionnaires and Survey Development: Principles of Good Practice

Goals/ABET Criterion (Criteria) Addressed

This session will present an introduction to good practices in the development of surveys designed to assess the new ABET criteria. Principles to follow when designing a survey or questionnaire to be used in collecting data on student outcomes will be presented

Presentation Format

The session will include several brief information-dense lecture periods each followed by an activity designed to help learn the pesented material. Participants will work in small groups on these activities. Attendees should have paper and pencil for idea development.

Session Summary

Principles to follow when designing a questionnaire or survey to be used in collecting data on student outcomes will be presented. Issues to be highlighted are: critical questions which need to be answered prior to instrument development, common mistakes to avoid, instrument structure and format, general principles of sampling, and on-line and Internet-based data collection.

Topics with activities will include developing a sampling design, development of mail survey, telephone, and interview instruments, and development of attitude questionnaires and observation protocols.

Key Words

Survey sampling, mail surveys, telephone surveys, attitude questionnaires

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Kish, L. Survey Sampling. NY: Wiley, 1965.
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ATTITUDE SCALING

I. Thurstone scaling

A. Selecting single concept, idea, or construct for scaling

eg. War, marriage, abortion, mathematics

B. Collection of statements about the concept: non-factual, opinion-oriented; select about 80-100 for analysis.

eg. I like arithmetic most of the time.
Abortions should never be performed under any circumstances.
War is usually a good thing, everything considered.

C. Placement of statement along 11 point continuum from (-) 1= most negative statement to (+) 11= most positive statement, with 6= neutral or nonjudgmental statement.

- use 50-200 subjects to do placement

- evaluate distribution of each statement:

Median:

for example, statement: Abortions should never be performed...

	1	2	3	4	5	6...
n:	150	50	0	0	0	0
	|					
%ile	50					
score	1.17					

for example, statment: Abortions should be performed only to save the life of the mother.

	1	2	3	4	5	6...
n:	10	40	90	40	20	0
			|			
%ile			50			
score			3.05			

Variability:

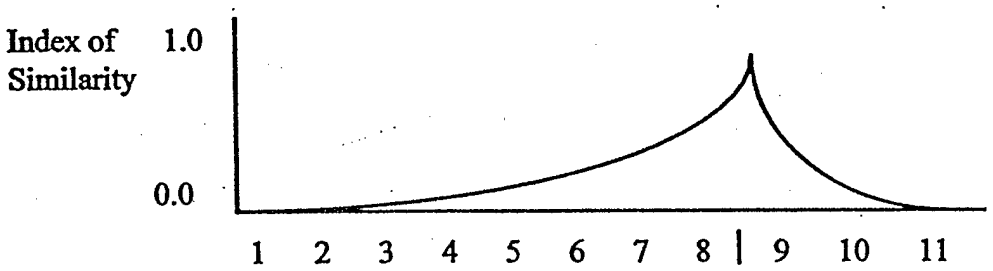
-eliminate items with ranges greater than 6 or 7
- examine conditional distributions of adjacent or close items:

* give items to 200-300 respondents to *endorse* each statement (+) agree or (-) disagree

* examine joint endorsements of one item (a) with another (b), using an index such as

$$I_{a,b} = n_{ab} / n_b$$

* the distribution of the ${}_aI_b$'s should decrease around item a on either side of its scale value; that is, items with similar scale values should have a high similarity index, while items further away on the scale should have scale values that drop away with distance. Throw out items with poor characteristics.



SAMPLING PRINCIPLES

(adapted from Kish, L. **Survey Sampling**. Wiley, 1965)

SAMPLING FEATURE	SIMPLEST VERSION	COMPLEX VERSION
Probability for selection	Equal probability for all persons	Unequal probabilities due to study conditions
Sampling	Sample each person	Sample first clusters of persons, then persons
Strata	Sample from entire population	Separate sample for various subgroups such as males/female
# of Phases	One sampling time	Samples drawn from initial sample that is used to get information

INTERVIEW PROCEDURES

1. Structure: Unstructured

   Partial Structure

   Semistructured

   Totally structured

2. When to use

3. Styles of interviews

   Nondirective

   Focused

   Multiple interviewers

   Multiple interviewees

4. Potential interviewer problems

5. Telephone interviews

6. Tips for interviewing

SURVEY QUESTIONNAIRE DEVELOPMENT

(adapted from Krathwohl, D.R. (1993). Methods of Educational and Social Science Research. New York: Longman.

Major Issues

1. What to ask

2. How to ask it

3. Tips on Question construction

    a. Understandable language

    b. Check interpretation

    c. Keep as short, simple as possible

    d. One concept/issue per question

    e. Avoid biased phrasing

    f. Framing the question

    g. Avoid potential embarrassment in responses

    h. Help negative responses by beginning positively

    i. Maintain impersonal orientation

    j. Avoid negative questions where possible

    k. Develop best range for multiple choice options

    l. Don't focus or bias responses by order of earlier questions

    m.

4. Ordering the Questions

5. Format

OPTIONAL EXTENDED YEAR PROGRAM EVALUATION

STUDENT SAMPLING PLAN 1996-97 Year

I. Characterizing OEYP Districts

School district reports from TEA were the basis for describing the number of students enrolled in the OEYP program for the 1996-97 school year. A total of 492 districts provided reported student enrollment. The distribution of number of students enrolled was the basis for sampling

Student enrollment varied from 2 students to almost 16,000. The empirical distribution was reviewed and provided meaningful breaks as follows:

District Enrollment	Number of Districts	Total # Enrolled	% districts Selected	% students Selected	# students Selected
Very Large (575-16,000)	50	100,629	100%	10%	10,000
Moderately Large (251-750)	73	23,580	25%	50%	3,000
Medium Size (100-250)	123	15,602	25%	100%	4,000
Small (31-99)	128	5,969	25%	100%	1,500
Very Small	118	1,947	75%	100%	1,500
Totals	492	147,727	45% (221)	13.5%	20,000

II. Sampling Procedure

Within each district size category above, all reporting districts were given equal weight. While the original plan was to sample the 28 districts that participated all four years, only one of the districts provided student lists for the 1995-96 school year, so that stratum was abandoned. Districts were selected using random numbers. If a district did not provide student data, it was replaced by the district immediately below it in alphabetical order.

On-site Interview (Administrator) Date_____Interviewer_____

District name_____ District #_____ Location of interview_____

Name of person interviewed_____ Current position_____

1) What was your involvement with OEYP in the District?

_____

2) What years were you involved with OEYP? __93/04 __94/95 __95/96 __96/97

3) What is the current status of OEYP in the district?.

_____

_____

Is OEYP being implemented in the 1998/99 school year ___Yes ___ No
or summer 1998? ___Yes ___No
Comment:_____

4) How was OEYP implemented in the district?

	Last year it was implemented:	**Previous years, if different:**
a) Extended format:	___Day ___ Week ___Year	___Day ___Week ___Year
Typical class sizes per teacher:	_____	_____
What was the number of days offered in OEYP?	_____	_____
	Last year it was implemented:	**Previous years, if different:**
What was the length of the instructional day?	_____	_____

b) Were centralized campus(es) used or did children attend their regular school?

_____ _____

_____ _____

c) How was transportation and breakfast/lunch handled?

_____ _____

_____ _____

_____ _____

d) Were any private sector services used in instruction or support?

_____ _____

_____ _____

e) Was there a parental involvement component?
___Yes ___No ___Yes ___No

e) Was there a parental involvement component?

___Yes ___No ___Yes ___No

How was it implemented?

_____ _____

_____ _____

Last year it was implemented: **Previous years, if different:**

f) Was there a professional development component for OEYP teachers? How was it implemented?

_____ _____

_____ _____

5) What were important aspects of the program focus and implementation in the last year of implementation?

_____

_____

How did these differ from previous years?

_____

_____

6) What were the greatest problems in operating OEYP? _____

_____

_____

_____

_____

7) What benefits did the District get from OEYP?_____

_____

Benefits for students? _____

_____

8) Is the District continuing OEYP? Yes__ No__

Why or why not?_____

_____

_____

Is the District eligible for funding in 1998-99? ___Yes ___No

9) Do you think the OEYP program was effective? ___Yes ___No

For students? ___Yes ___No

Would you support continuing the OEYP program? With or without State support? Why or why not?

_____

_____

_____

Assessing the Effectiveness of the First Two Years' Mathematics Curriculum in an Engineering School

Session Summary:
Colorado School of Mines (CSM) recently instituted a major curriculum revision. The process started with the Academic Planning Committee's formulation of the "Profile of the Colorado School of Mines' Graduate." The Curriculum Reform Steering Committee (CRSC) was formed to guide the planning and implementation of the revisions necessary to comply with the "Profile." Sub-committees were formed to examine our curriculum and its fit with that document, to study what comparable institutions were teaching, and to determine the changes we needed to make. The CRSC developed a curriculum framework that was adopted by the faculty. This paper is concerned with the formulation of the first two years' mathematics courses.

Needs Assessment: The Mathematics and Basic Sciences Sub-committee (MBS), made up of faculty from all of the departments, discussed at length what requirements were needed in mathematics, physics, and chemistry. The committee recommended that the calculus/differential equations sequence go from a 4-3-3-3 credit hour sequence to a 4-4-4-4 one. They developed lists of topics to be included in each course and examined how those topics matched with the comparable science classes. Departments were asked to provide input for the new courses in mathematics and the basic sciences. Several Faculty Forums were held to discuss the framework and the content of courses.

Planning New Courses: Students at CSM traditionally take the second semester of calculus and the first semester of physics during the spring semester of their freshman year. For physics, the students need vectors. For physical chemistry, the students need partial differentiation. As many of the traditional second semester calculus topics, such as techniques of integration, have become less essential in this era of symbolic manipulators, these were eliminated in the new courses. The new Calculus for Scientists and Engineers II consists of vectors, lines, curves, planes in space, partial differentiation, and multiple integration. The third semester course is surface and line integrals, Green's and Stokes' theorem, sequences and series, and techniques of integration as they apply to the solution of differential equations. The third semester topics support the Physics II course and the second course in Physical Chemistry. All calculus courses have a strong problem-solving component. The Undergraduate Committee of the Mathematical and Computer Sciences Department took the input from MBS and the other departments and developed the performance objectives and syllabi for the new courses.

Development of Problems that Reflect the Language of Science and Engineering: Engineering and science faculty complained that students finished their calculus sequence unprepared or under-prepared to do the mathematics in their courses. They commented that students had difficulty translating the calculus into new concepts where problems appeared to be different. A set of problems was developed using material from other disciplines. The intention was not to teach the scientific or engineering concepts, but to

concentrate on the mathematics being used to develop the concept. The problems were collected by interviewing faculty members in person and by email.

Methods of Assessment: There are two levels of assessment: assessment of student work and evaluation of the new courses. Exams reflected the new curriculum and emphasized problem solving rather than mechanics. In the semester that the switch was made from the old courses to the new, a common portion of the final examination in the old Calculus III and new Calculus II revealed that the students were able to learn the multivariate material earlier in their careers. That common final exam was written by an instructor who was not teaching either of the two courses and was developed from a template that divided problems into conceptual, mechanical, and applications. A Calculus I problem was included on the exam. Most students did not recognize its simplicity and wanted to make it more complicated than it was. The Physics department administered a Mathematics diagnostic examination that reiterated that terminology is often the problem. Students completed evaluative questionnaires each semester. Each faculty member in the Mathematical and Computer Sciences Department completed a survey this year that is presently being processed.

Feedback Mechanisms: A workshop was held for teachers from the local high schools and community college to share results about the new curriculum. A web page has been established to help facilitate this process. The results of the faculty survey will be shared at a faculty meeting in the fall and necessary changes will be made. The student questionnaires reveal that the students like the problem solving sessions and feel that they have deepened understanding. Both faculty and student surveys will be used to provide continuous improvement. Surveying other departments for input is a process used in developing the new computer science course, differential equations, probability and statistics, and numerical methods. We plan to follow-up by asking those departments if they notice changes in students' performance.

Goals/ABET Criterion Addressed: The session addresses ABET Criterion 3 a) "Engineering programs must demonstrate that their graduates have an ability to apply knowledge of mathematics, science, and engineering."

Presenter:

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Profile of the Colorado School of Mines Graduate

- All CSM graduates must have depth in an area of specialization, enhanced by hands-on experiential learning, and breadth in allied fields. They must have the knowledge and skills to be able to recognize, define and solve problems by applying sound scientific and engineering principles. These attributes uniquely distinguish our graduates to better function in increasingly competitive and diverse technical professional environments.

- Graduates must have the skills to communicate information, concepts and ideas effectively orally, in writing, and graphically. They must be skilled in the retrieval, interpretation and development of technical information by various means, including the use of computer-aided techniques.

- Graduates should have the flexibility to adjust to the ever-changing professional environment and appreciate diverse approaches to understanding and solving society's problems. They should have the creativity, resourcefulness, receptivity and breadth of interests to think critically about a wide range of cross-disciplinary issues. They should be prepared to assume leadership roles and possess the skills and attitudes which promote teamwork and cooperation and to continue their own growth through life-long learning.

- Graduates should be capable of working effectively in an international environment, and be able to succeed in an increasingly interdependent world where borders between cultures and economies are becoming less distinct. They should appreciate the traditions and languages of other cultures, and value diversity in their own society.

- Graduates should exhibit ethical behavior and integrity. They should also demonstrate perseverance and have pride in accomplishment. They should assume a responsibility to enhance their professions through service and leadership and should be responsible citizens who serve society, particularly through stewardship of the environment.

Research Question: What are the project objectives?	Implementation Strategy: How will the objectives be met? Which project activities help you meet each objective?	Evaluation Methods: How will you know the objectives have been met? What measurements will be made? On whom?	Timeline: When will measurements be made?	Audience Dissemination: Who needs to know the results? How can you convince them the objectives were met?
Overriding Goal: Develop authentic assessments to evaluate the new mathematics curriculum.	Two four credit Calculus II & III courses will run in parallel, each of which will have forty-five students chosen randomly. One course will have two out of four hours directed towards solving problems in class. The other will rely on conventional lectures and homework assignments. The instructors will be alternated after the first semester. Repeat the second year.		Spring, 1998 through Fall, 2000	• Local high schools and community colleges. • Other departments on the CSM campus. • Other calculus programs. Results from student measurements will be distributed.
First Objective: Test the effect of problem-solving sessions on student achievement and understanding of concepts.	• Trained graduate students and high school teachers will observe each of the classes. • Students will be tested at the beginning and the end of the semester. • Classes will be observed throughout the semester.	• Classroom observation by trained high school teachers and/or graduate students. • Student problem-solving journals and/or portfolios. • Testing • Interviewing students about their problem-solving abilities. • Self and peer assessments.	Spring, 1998 Fall, 1998 Spring, 1999 Fall, 1999	• Local high schools and community colleges. • Other departments on the CSM campus. • Other calculus programs. Course outlines and problems will be maintained on web pages.
Second Objective: Develop methods to quantify the success of students in subsequent courses.	• Student progress will be followed through other courses for an additional two and one-half years. • Both non-mathematics and mathematics faculty will evaluate students skills in their courses.	• Comparing student records from students completing the problem-solving courses with those from students in the other classes (grades, overall GPA, etc.). • Evaluating exams from upper-division courses for evidence of problem-solving skills. • Interviewing students about their perceptions of their problem solving ability. • Gathering data from faculty about students' performance using methodology developed by Gloria Rogers at Rose-Hulman Institute of Technology.	Spring, 1999 Fall, 1999 Spring, 2000 Fall, 2000	• Other departments on the CSM campus. • Other calculus programs.
Third Objective: Measure change in the climate of the calculus classroom.	• Students will be asked whether the new instruction techniques have aided their understanding. • Instructors will be asked to make comparisons of new techniques vs. old techniques.	• Attitude surveys • Student journals. • Focus groups with students. • Classroom observations by outside experts.		• Other calculus programs.

Table 1: Summary of Goals, Objectives, and Evaluation Methods

Calculus Survey

Because of comments about the mathematical abilities (or lack of) of students exiting the calculus program at CSM, we are trying to develop a set of calculus problems which are directly related to concepts seen in courses in all other disciplines on campus. We have selected faculty members from whom we feel we will receive helpful input. We would appreciate your responses to these questions.

1) Would you provide a specific list of mathematical topics or skills which pose difficulty for your students?

2) Do you feel that your students have forgotten the math, never learned the math or are confused about the change in vocabulary or symbols?

3) Do you find yourself re-teaching math?
   a) If so, how much time do you spend on this?
   b) If not, do you ask students to review the concepts on their own?

4) Would you be willing to contribute some problems from subjects you are teaching whose solutions involve the use of calculus? We would appreciate having this input as soon as possible.

We appreciate your time in helping us with this project. We feel the students who worked on these problems last semester really benefited from that experience. Thanks.

7.12 Flow of a Gas Mixture through a Tank

Calculus Topic:	Differential Equations
Department:	Chemical Engineering
Subject Area:	Process Simulation and Analysis
Time Needed:	40 minutes
Reference:	[30]

When a gas is placed in a tank, it expands to fill the whole volume of the tank. Because of this pressure must be considered as the measurable representation in this problem. The ideal gas law

$$PV = nRT \tag{7.28}$$

can be used to relate pressure to the other conditions in the tank. In (7.28), P is the pressure in the tank, V is the total volume of the tank, n is the total number of mols of gas, R is a gas constant and T is the absolute temperature.

Consider the tank system in Figure 7.23 which has a two-component ideal gas mixture at a constant temperature. The gas mixture is being added to the tank at a flow rate (mols

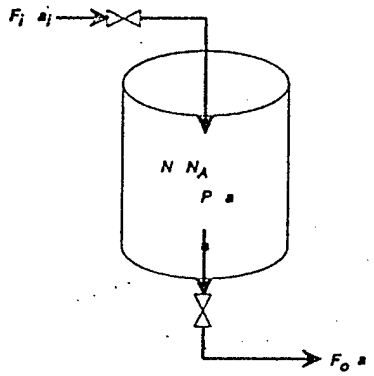


Figure 7.23: Ideal gas mixture at a constant volume and temperature.

per amount of time) of F_i with a_i being the percent of the composition of component A. The flow rate of the gas out of the tank is F_o with a being the percent of the composition of A leaving the tank since a is the percent of the composition of A in the tank. In the tank at any time, there are N mols of gas mixture of which N_A mols are of composition of A; at pressure P and a is the percent of the compositon of A in the tank. From (7.28) we can find that

$$N = \frac{PV}{RT} \qquad \text{so that for A} \qquad N_A = aN = \frac{aPV}{RT}.$$

Considering an overall mole balance for the system,

$$\frac{dN}{dt} = \frac{d\left(\frac{PV}{RT}\right)}{dt} = F_i - F_o \tag{7.29}$$

The mole balance for component A is

$$\frac{dN_A}{dt} = \frac{d\left(\frac{aPV}{RT}\right)}{dt} = a_i F_i - aF_o \tag{7.30}$$

Troublesome Notation: The differential notation is also confusing when substitution takes place. For example, $\frac{dN}{dt} = \frac{d\frac{PV}{RT}}{dt}$ is a simple substitution of $\frac{PV}{RT}$ for N. $\frac{d\frac{PV}{RT}}{dt}$ simplifies to $\frac{V}{RT}\frac{dP}{dt}$ since V, R and T are constants.

1. Let $F_i = 0$ so that the tank is being emptied. Let the gas leave the tank at a rate proportional to the difference between the tank pressure and the pressure of the atmosphere, P_{atm}, a constant. Then the overall mole balance equation is

   $$-k(P - P_{atm}) = \frac{d\left(\frac{PV}{RT}\right)}{dt}$$

   where the ideal gas law is used to write N is terms of P. Considering that V, T and R are constant and that when $t = 0$, the pressure is P_o, find the pressure as a function of t at any time.

2. Now consider a non ideal gas which behaves according to the non ideal gas law

   $$PV = ZnRT \qquad \text{where} \qquad Z = 1 + \frac{BP}{RT} \tag{7.31}$$

   where B represents the degree of departure from non-ideality at low pressures and is constant for constant temperature processes. As in problem (1), Let $F_i = 0$ so that the tank is being emptied, but this time assume that the tank is emptying at a constant rate, that is, F_o is constant. If the pressure in the tank is P_o at $t = 0$, set up the differential equation and solve for P.

CURRICULAR INNOVATIONS OUTCOMES ASSESSMENT

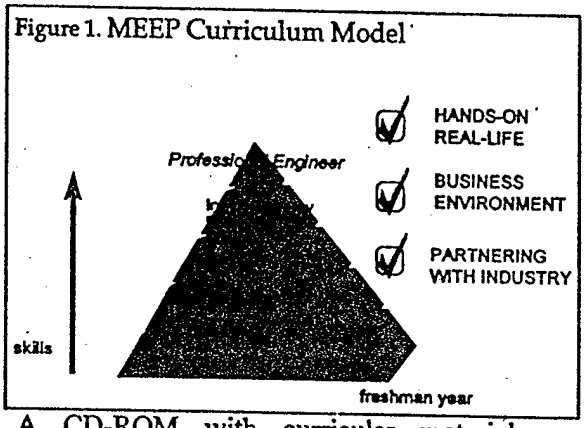
ABSTRACT

This presentation will describe how the Manufacturing Engineering Education Partnership (MEEP) designed its **assessment strategy** to evaluate the outcomes of a curricular innovation project called **The Learning Factory.** A total of 9 assessment instruments developed, some in collaboration with industrial partners, utilized for assessing **overall and specific qualitative aspects** of the program as well as **student** performance (e.g., teamwork skills and oral presentation/written skills) are described. We believe that the Learning Factory as well as the project's assessment strategy and tools used comply with the new ABET Engineering Criteria 2000 (criteria 2 and 3).

SUMMARY

The Manufacturing Engineering Education Partnership (MEEP), a coalition of institutions who in response to industry needs, has developed an innovative manufacturing engineering curriculum option and physical facilities for product realization (See Figure 1). This program offers a new paradigm for engineering education, providing a balance between theory and practice and emphasizing the development of basic skills in the student. The desired skills include communication, teamwork, business concerns and project management. Detailed information about the program can be found in the website, http://lfserver.lf.psu.edu/LF/col_home.html. A CD-ROM with curricular materials and publications can be requested.

Figure 1. MEEP Curriculum Model



ASSESSMENT STRATEGY AND TOOLS

Developing MEEP's assessment strategy proceeded rather easy because the project's goals and objectives had been clearly defined in the project's Strategic Plan. An assessment team was formed and the strategy discussed and shared with all the constituents (faculty, students, and industrial partners). Because the granting agency (NSF) already had specified the quantitative data to be gathered, the assessment strategy focused on the qualitative aspects of the program. Once the project's goals were outlined, four matrices were developed (one for each of the project's tasks) which contained general and specific questions we thought the project's constituents wanted to be answered. Table 1 presents a sample from one of the matrices created. These matrices helped the assessment team develop the data collection approach and design the assessment instruments/ tools for the different audiences. Assessment tools are also included.

ASSESSMENT INSTRUMENTS/TOOLS

In this section, several of the assessment instruments/tools utilized are presented in three categories: ***Project/Program Assessment Tools, Student Performance Assessment Tools, and, Course and Curricular Materials Assessment Tools.*** Some of the instruments were used coalition-wide and others were used at one or more of the partnership universities. Some of the tools (e.g., surveys, focus group

questions) were developed with the help of our industrial partners. Assessment results have been published elsewhere.[1]

Project/Program Assessment Tools

- *Surveys*: Four surveys were developed from the assessment matrices, focused on different audiences: students, faculty, industry and other institutions. Issues and items in the surveys reflected some of the ways in which MEEP could be described. Questions ranged from individual perceptions of the quality of specific courses and activities, to faculty evaluations, relationship with industry, to more general questions surveying the overall impact. (See industry survey).
- *Industry/Faculty Focus Group*: Faculty and industrial partners from the three institutions discussed their experiences and their perceptions as to what made the partnership a success. A discussion group was created on-line, and opinions shared and gathered for a period of two months.
- *External Assessors:* A group of experts - who either had experience in manufacturing engineering, or were familiar with our work or with similar partnerships/ learning goals - evaluated the project's deliverables. They participated in partnership meetings, talked to industry partners, students and faculty, visited facilities, completed the survey, or browsed course materials in national conferences and meetings.

Student Performance Assessment Tools

- *Teamwork skills assessment instrument:* In order to assess the students' performance in working in teams, an assessment instrument or form was developed. The form asked students to explain their decision-making process during a specific task they had to achieve (for example, design phase) and their strategies to solve conflicts in design teams. Besides assessing student performance for grading purposes, this tool helped faculty to detect if students needed more training on how to work in teams. Answers provided by the students were discussed in class.
- *Peers Evaluation Form:* At the end of the semester, students evaluate peers in their teams. They assess each team member in terms of the effort (0-3) and the grade they assess the work (in percent).
- *Oral/written communication assessment instruments/tools:* Two assessment tools were used to evaluate the students' oral and written communications skills. These forms were used by faculty as well as peers in evaluating student oral presentations and written reports. Feedback from peers was provided to the student teams at the conclusion of the presentation.

Course and Curricular Materials Assessment Tools

- *Course Evaluation and Assessment of Skills and Knowledge Instrument:* In order to evaluate the mastery and level of knowledge and skills developed by the students in MEEP courses and to establish the effectiveness of lectures and experiences, as well as course logistics, an assessment instrument was designed. The faculty member, customizing it to the individual course adapts this generic template.
- *Lecturer Evaluation Form:* Some of the MEEP courses offered at UPRM are team taught. A lecturer evaluation instrument was designed to determine each individual lecture's effectiveness.
- *CD-ROM Curricular Materials Assessment Tool:* One of the products of the program is a CD-ROM with all the curricular/course materials developed. An assessment form was included in the CD-ROM to evaluate the contents as well as the quality of the materials in the CD-ROM.

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[1] Lueny Morell de Ramírez, José L. Zayas, John Lamancusa, Jens Jorgensen, *The Manufacturing Engineering Education Partnership: Program Outcomes Assessment Results,* Frontiers in Education Conference Proceedings, Pittsburgh, November, 1997.

urriculum Development Matrix (sample)

Question 1: Was a new interdisciplinary, practice-based curriculum which emphasizes the interdependency of manufacturing and design, in a business environment developed?			
Subquestions	Data Collection Approach	Respondent (students, faculty, industry)	Schedule*
1a. Did the program allow students to practice their engineering science fundamentals in the solution of real problems?	Questionn-aire (Q) or Focus Group (FG) Samples	S, F, I	
1b. Are professional communication and team skills taught and learned?	Q or FG Samples Interviews	S, F, I	
1c. Are case studies, active learning techniques, and computer technologies extensively used in the classroom?	Q or FG Samples	S, F	
1d. Did the program provide previously unavailable opportunities for hands on engineering experience in the Learning Factory?	Q or FG	S, F	
1e. Did the partner schools exchange information and learn from each other's experiences?	Q or FG	S, F, I	
1f. Did students take courses with students from disciplines other than engineering?	Q or FG	S	
1g. Did faculty develop or modify courses to accommodate multiple engineering disciplines?	Q or FG	F	
Question 2: Was a new paradigm for coalition-wide courses development, sharing and export to the academic community at-large developed?			
Subquestions	Data Collection Approach	Respondent s	Schedule
2a. Were resources and ideas shared, avoiding redundant efforts? Were new technologies for communication utilized, achieving consensus on curriculum content?	Q or FG Samples	S, F, I	
2b. Were jointly developed curriculum materials easily transported among the MEEP partners, and exported to the academic community at large?	Q or FG	S, F	
2c. Were computer technologies, multimedia and electronic communications used in curriculum development?	Q or FG Samples	S, F	
2d. Did you participate with partnership professors to develop course materials? How effective?	Q or FG	F	

* assessments all carried out at the conclusion of the project

INDUSTRY SURVEY

The Learning Factory is a new practice based curriculum and physical facilities for product realization that has been developed at three institutions: Penn State University, the University of Washington, the University of Puerto Rico at Mayagüez in collaboration with Sandia National Labs. Its goal is to provide an improved educational experience that emphasizes the interdependency of manufacturing and design in a business environment. The key element in this approach is active learning - the combination of curriculum revitalization with coordinated opportunities for application and hands on experience.

This questionnaire has been designed to assess the performance and products of this program. Please answer it to the best of your knowledge.

Name: _____ **Company:** _____

Partner University:

[ ] UPR-M [ ] PSU [ ] UW [ ] Other_____

Your Involvement with the program:

[ ] Member of Industrial Partner Board [ ] Expert in the classroom [ ] Involved with students projects

[ ] Other_____

Instructions:

The following items reflect some of the ways in which the Manufacturing Engineering Partnership (MEEP) can be described. Please fill in the numbered circle, which indicates THE DEGREE TO WHICH YOU AGREE that each item is descriptive of the experiences you were exposed to and provided by the program. If you have no information or feel an item does not apply, please fill in the N/A (Not Applicable) circle.

5 - Strongly Agree 4 - Agree 3 - Neutral 2 - Disagree 1 - Strongly Disagree N/A

The program allowed students to practice engineering science fundamentals in the solution of real problems.	5	4	3	2	1	N/A
Professional communications skills were enhanced.	5	4	3	2	1	N/A
Teamwork skills were enhanced.	5	4	3	2	1	N/A
The partner schools learned from each other's experience.	5	4	3	2	1	N/A
Resources and ideas were shared, avoiding redundant efforts.	5	4	3	2	1	N/A
Real life problems were provided.	5	4	3	2	1	N/A
New technologies for communication were utilized on curriculum content.	5	4	3	2	1	N/A
The local Industrial Advisory Board (IAB) provided quality strategic and operation guidance to the local institution.	5	4	3	2	1	N/A
The local IAB supported MEEP's activities providing financial and/or non financial resources.	5	4	3	2	1	N/A
There was good communication between industrial sponsors and the institution.	5	4	3	2	1	N/A
Each institution provided the IAB the right information in a timely fashion.	5	4	3	2	1	N/A
The MEEP's Industrial Advisory Board (IAB) evaluated the overall progress of the program.	5	4	3	2	1	N/A
The partnership reported progress and activities related to participation in curriculum development.	5	4	3	2	1	N/A
The MEEP's IAB provided support in actions/activities that are relevant to the program.	5	4	3	2	1	N/A
The partnership reported progress and activities related to participation in the classroom teaching.	5	4	3	2	1	N/A
Students completing the MEEP program are more useful to our industry.	5	4	3	2	1	N/A
My industry and company is more likely to hire a MEEP trained student than a traditionally trained student.	5	4	3	2	1	N/A

Would you encourage other companies to participate in the program and coalition? Why?

What can be improved with MEEP?

Comments:

University of Puerto Rico
Mayagüez Campus
ADMI 3100 - TECHNOLOGY BASED ENTREPRENEURSHIP

TEAMWORK EXPERIENCES ASSESSMENT FORM

Please answer the following questions regarding your work as a team for the completion of the required task.

TASK(S): PRODUCT DESIGN, DECISION-MAKING

1. In chronological order, list what your team did during the design phase. Explain how tasks were distributed, how decisions were made.

2. What facilitated the decision-making process?

3. What was your contribution to the team when decisions had to be taken?

4. What do you think you would like to do differently the next time when working in a team?

NAME_____ TEAM_____

MANUFACTURING ENGINEERING EDUCATION PARTNERSHIP
University of Puerto Rico -Mayagüez

COURSE EVALUATION and ASSESSMENT OF SKILLS and KNOWLEDGE

Course: _____ Instructor: _____

The purpose of this assessment is:

- to determine your perception of mastery/level of knowledge and skills developed by the students in this course, and
- to establish the effectiveness of lectures and experiences, as well as of the logistics used.

The results of this assessment will help the instructor in charge of the course to better plan and adjust the course's agenda in the future.

PART I: GENERAL OBJECTIVES AND SKILLS

Directions:
Using the scale below, please evaluate (*) your perception of the mastery of skills and experience the students developed in this course in the areas specified.

N: no skills/no experience
R: rudimentary skills/very little experience
F: functionally adequate skills/some experience
A: advance skill/extensive experience

area	*
skill 1	
skill 2	
objective 1	
objective 2	

PART II: CONTENT, LECTURES AND EXPERIENCES

Directions:
In this part, please indicate (*) your perception of the lectures and activities' effectiveness, using the following scale:

0: not effective; would eliminate
1: moderately effective; significant changes (specify)
2: effective; minor changes (specify)
3: very effective; would not change

module/lectures	*	comments
Module 1: TITLE		
Module 2: TITLE		

PART III: COURSE LOGISTICS

Directions:
Please indicate (*) how you feel regarding the various aspects designed for the course, using the following scale:

0: inadequate; disliked, needs re-engineering!
1: somewhat adequate; needs enhancement
2: adequate; minor changes
3: adequate; no change

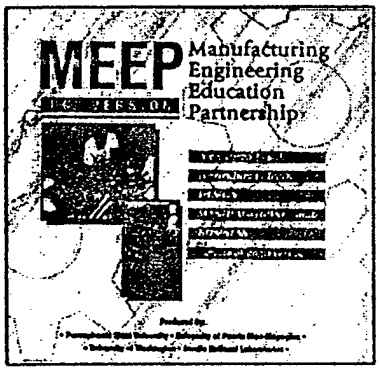
area	*	comments
Number of meetings		
Kinds of assessment techniques		
Requirements		
Number of lectures		
Number of plant trips		
Topics covered		
Course coordination		
Other:		

Would you recommend this course to other students? Explain.

Do you think your expectations were met? YES/NO. Explain.

Suggestions:

Your overall rating of the course: _____/10.



The Manufacturing Engineering Education Partnership (MEEP)
CD-ROM Assessment Form

Please review this CD-ROM and, to the best of your knowledge, answer the questions that follow regarding the contents and quality of the curricular materials included. We would also like to know how useful these materials could be to you or to any institution willing to adopt or adapt them. Your feedback will help the Partnership in its effort to fine tune the curricular products developed.

Name	
Position	
Institution	
Address	
	Phone: Fax: email:

The MEEP CD-ROM contains the following items:

Background Information

- Information about MEEP
- Video
- MEEP Publications

Course Materials

- Product Dissection Course
- Technology-based Entrepreneurship Course
- Concurrent Engineering Modules
- Process Quality Engineering Course
- Rapid Prototyping Technology Module

I. Regarding **Background Information**:

Did you understand the program, as described in the ***Information about MEEP*** section?

Was the ***video*** about the program useful in understanding the goals and objectives of the Partnership?

Did the publications about MEEP provide more details about the different aspects of the program (e.g. goals, approach, products, assessment)?

Regarding the **Course Materials:**

How would you rate the content and quality of the course materials?
Use the following rating: *1 (poor); 5 (excellent)*

	Content	*Quality*	*Comments*
Product Dissection Course			
Entrepreneurship Course			
Concurrent Engineering Modules			
Process Quality Engineering Course			
Rapid Prototyping Technology Module			

III. Regarding the use of the contents of the CD-ROM

Will you use the curricular materials included? If the answer is *yes*, how would you use them?

IBOGRAPHICAL INFORMATION

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File:papers/best-assessment-98-outline-final.doc

DEVELOPING A SCHOOL-WIDE ASSESSMENT PLAN: LESSONS LEARNED AND QUESTIONS RAISED

Goals/ABET Criterion 3 Addressed

This presentation addresses ABET EC2000's Criterion 2, Program Educational Objectives, and Criterion 3, Program Outcomes and Assessment. We describe the process that has led our school from a state of outcomes assessment (OA) resistance to outcomes assessment acceptance. This session is intended for anyone who is involved in moving assessment forward in his or her organization.

Presentation Format

This presentation will use a panel discussion format with open-ended invitation for conference attendees to contribute to the discussion throughout the presentation. Panelists from the Purdue School of Engineering and Technology at IUPUI will present the responses of five faculty constituencies to questions that we have had to answer as we made the transition from resistance to acceptance. The five faculty constituencies include the department chairs, the dean's office, the junior faculty, the resistant faculty, and the chair of the school-wide assessment committee.

Session Summary

Our story will unfold in a Frequently Asked Questions (FAQ) format, with panelists presenting frank and honest responses to series of questions that have been carefully selected and arranged to paint a complete picture of our transformation from resistance to acceptance. This presentation will bring into the open what is often heard only in private conversations. We will describe (1) the resistance and objections that we have had to overcome, (2) the questions we have had to answer, (3) the current level of cooperation and faculty buy-in, (4) the lessons we have learned, (5) the organization of the faculty over sight committee that facilitated the transformation, and (6) the support we have received from the dean's office and the campus administration. In addition, we will describe (7) our accomplishments to date, and (8) we will present a list recommendations for deans and chairs of faculty leaders. Finally, (9) we will conclude with a disclosure of questions that we have yet to answer, bringing the audience into the program to brainstorm possible resolutions to the questions.

The tables of information presented in this session were condensed from a more comprehensive set due to the time allotted and the number of pages allowed. We have produced a brochure that contains the complete tables and other information that may be useful to you. A URL for a web site containing this brochure will be announced at the Symposium. If you did not receive this handout or the URL, you may contact Charles Yokomoto at the address listed below. A related paper can also be found in the proceedings of the 1998 Frontiers in Education Conference [1].

Key Words

Outcomes assessment, culture, resistance, buy-in, assessment process, school-wide assessment committee, support

Bibliography

[1] Yokomoto, C.F., Goodwin, C., and Williamson, D., "Development of a school wide assessment plan--questions answered and questions raised," Proceedings of the 1998 Frontiers in Education Conference, Nov. 1998, Tempe, AZ.

Session Presenters

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DEVELOPING A SCHOOL-WIDE ASSESSMENT PLAN: LESSONS LEARNED AND QUESTIONS RAISED

TABLE 1. WHY DID WE DEVELOP THIS PROGRAM?

- To help others move forward in outcomes assessment.
- To share our experiences in turning our faculty's position from outcomes assessment resistance to outcomes assessment acceptance with a committee structure that is faculty driven,
- To give a balanced presentation from multiple perspectives rather than a one-sided presentation with positive spins.
- To help you understand what may be going on in the minds of the major players in your school.
- To bring forward some of the issues that faculty must confront if faculty are to buy into outcomes assessment.

TABLE 2. WHAT WERE SOME OF THE EARLY OBJECTIONS OF THE FACULTY TO OUTCOMES ASSESSMENT?
(For North Central Association Accreditation and ABET Accreditation)

Issue	Source	Response
ABET's new criteria is too vague. Why doesn't someone just tell us what to do?	Faculty	Don't confuse vagueness with flexibility. Experts speak in general terms because the process will depend on the particulars of the school.
We may have to contend with a high degree of subjectivity among the ABET evaluators under the new criteria.	Faculty	That's nothing new. We already have reports of subjectivity under the old criteria.
No one has said that our graduates were substandard. They seem to be getting jobs.	Faculty	Outcomes assessment helps you to demonstrate that your graduates are as good as you think they are and that they are getting jobs as well as improve them.
Under the new ABET criteria, we won't know where to set the bar so that it will meet with ABET's approval.	Faculty	Involve your industrial constituents as described in the new criteria.
Outcomes assessment will be difficult to accomplish in departments where many courses are covered by part-time faculty.	Department chairs	This is a problem. On the positive side, this will improve communication between your full-time and part-time faculty, while adding to quality improvement in your courses.
It will be difficult to get faculty to participate, let alone buy in.	Department chairs	
The process looks excessive in light of increased demands for output in service, publications, and external funding. Senior faculty should be responsible for this. Unfortunately, some departments have few senior faculty.	Junior faculty	We agree. Thus, the best advice we can give is to build as much of outcomes assessment into the regular teaching activities of your faculty and make use of as much of your current assessment methods as you can.
It looked like the university was taking a top-down approach to accomplish NCA outcomes assessment.	Dean's office	This misunderstanding was due to a gap in communication between the dean's office and the school's representative to the campus assessment committee.

Outcomes assessment for NCA accreditation looked like more academic busywork.	Faculty	This objection abated when ABET announced its new outcomes driven process for engineering accreditation. Also, Industry is heavily into assessment in the form of quality control, TQM, and IS 9000.
Assessment gurus keep describing an ideal process without focusing on what is practical.	Committee chair	Once re recognized this, we develop our own level of practicality. The experts are designing their perfect baby. They are not telling us what we have to do.

TABLE 3. WHAT ARE SOME OF THE REMAINING HURDLES?

Hurdle	Source
Convincing chairs and faculty that the benefits will be worth the extra effort.	Dean's office
Getting faculty to participate without any administrative clout.	Committee chair
Protecting against doing so much assessment that other aspects of work suffer.	Faculty
Getting faculty to accept assessment as part of the job, even if it does not contribute significantly to faculty advancement.	Department chairs
Learning how to do outcomes assessment, which we weren't trained to do in our graduate studies.	Junior faculty

TABLE 4. WHAT ARE OUR SCHOOL ACCOMPLISHMENTS TO DATE?

Activity	Completion Date
A school-wide general education outcomes assessment plan was written for inclusion in the campus North Central Association accreditation report. The plan was very elementary has since been replaced.	Fall, 1994
A plan for assessing writing and critical thinking, two of the six campus general education principles, was developed for the campus general education assessment initiative.	1996-97 academic year
A school workshop on writing course objectives was conducted.	1997-98 academic year
Departments wrote their broad goals and objectives in relationship to the mission statements of the campus and school.	1997-98 academic year
An assessment process for the remaining campus general education principles was developed.	1997-98 academic year
Learning objectives were written for all Spring '98 semester courses taught by full time faculty, with objectives for the remainingg courses to be completed by August 1, 1998.	1997-98 academic year
The School conducted a faculty forum to discuss the university's general education principles.	1997-98 academic year
We developed our own outcomes assessment process after we tried to implement a published process without success.	1997-98 academic year
We developed a glossary of terms to minimize confusion and disagreements caused by terminology.	1997-98 academic year

TABLE 5. WHAT IS THE CURRENT STATE OF OUTCOMES ASSESSMENT IN OUR SCHOOL?	
The faculty are cooperative and active, but a little short of buy-in and total commitment.	Committee chair
Department chairs are planning a retreat, part of which will be spend on outcomes assessment.	Department chair
We accept the realities of outcomes assessment, and we are hopeful that it will be beneficial.	Faculty
Buy-in is slow, but steady and satisfactory.	Dean's office
The learning curve is steep.	Junior faculty

TABLE 6. WHAT IS THE COMPOSITION OF OUR SCHOOL'S OUTCOMES ASSESSMENT COMMITTEE?
• The chair is appointed from among the ranks of the full-time faculty, not from among the administrators in the school. • Each department is represented by its chair and one or more faculty members. The Technical Communications program, which does not grant degrees, is represented. • The dean's office is represented. • The dean attends as many meetings as possible.

TABLE 7. WHAT ARE SOME OF THE FACTORS THAT MOTIVATED FACULTY ACCEPTANCE OF OUTCOMES ASSESSMENT?	
Motivating Factor	**Source**
• ABET's move to incorporate outcomes assessment in the accreditation process. • A new dean who is committed to outcomes assessment.	All
• Shift of focus from the teacher to the learner.	Department chairs
• Faculty got tired of talking about assessment and wanted to begin implementation. • Faculty do not want to see programs lose accreditation.	Faculty
• Persistence of school administration and the school's assessment committee.	Dean's office
• A desire to demonstrate that the junior faculty members are team players.	Junior faculty

TABLE 9. WHAT WILL IT TAKE TO OVERCOME ANY REMAINING OBJECTIONS?	
Item	**Source**
• Rewards and recognition, including reassurance that assessment work is valued and counts toward promotion and tenure.	Junior faculty
• More resources, including time to adjust to the new process.	Department chairs
• A plan to accomplish outcomes assessment without increasing the workload.	Faculty

TABLE 10. WHAT HAS OUR DEAN DONE TO SUPPORT OUTCOMES ASSESSMENT?
• He has been vocal in his support of outcomes assessment. • He has attended nearly all of our committee meetings. • He has provided release from teaching for key personnel, particularly the chair of the school-wide assessment committee. • He has instituted competitive summer grants for outcomes assessment activities. • He has sent faculty members to conferences that focus on outcomes assessment. • He included a segment on outcomes assessment in his address to the faculty at a faculty convocation. • He has appointed administrative liaisons between the dean's office and the committee to handle administrative matters. • He signs off on memos to department chairs and faculty members requesting assessment products and documents. • Last, but not least, he has provided box lunches for committee meetings, which has changed the mood of the meetings.

TABLE 11. WHAT OUTCOMES ASSESSMENT ACTIVITIES ARE ON OUR AGENDA THIS SEMESTER?		
Activities	**Starting Date**	**Completion Date**
Assessment Committee will begin writing learning outcomes, aided by a work session on writing assessable learning outcomes starting with ABET's Criterion 3 for EAC and Criterion 1 for TAC.	Sept. 1998	Dec. 1998
Assessment Committee will continue working on helping departments select their primary assessment strategy, i.e., capstone project, comprehensive exam, FE exam, select courses, etc.	Sept. 1998	Oct. 1998
Engineering programs will continue working on strategy for assessing students at the two-year point.	Sept. 1998	Oct. 1998
We will continue working with Office of Information Management and Institutional Research on developing alumni survey instruments.	Sept. 1998	Nov. 1998
We will begin developing plans to survey industries and businesses on quality of graduates.	Oct. 1998	
We will begin development of tools and strategies for assessing general education for our 2002 NCA accreditation visit.	Oct. 1998	
We will Involve constituents (industry, community, and students) in defining objectives and outcomes.	Nov. 1998	

TABLE 13. WHY DID WE DEVELOP OUR OWN OUTCOMES ASSESSMENT PROCESS INSTEAD OF ADAPTING A PUBLISHED PROCESS?	
Reason	**Source**
▸ The published plan we adopted was not implemented successfully in a trial run, and no clear-cut, easy to implement process emerged.	Committee members
▸ Faculty wanted a written process that clearly spelled out the steps of an assessment process.	Faculty
▸ Writing our own process would lead to better understanding because we could define our terms..	Committee chair

TABLE 14. WHAT DIFFICULTIES DID WE HAVE WITH PUBLISHED PROCESSES?	
Difficulty	**Clarification and Examples**
Terminology was not clearly defined, resulting in differences of opinion due to interpretation rather than substance. The process published by Aldridge and Benefield in the May-June 1998 issue of Prism does define terms, but it was published after we wrote our own process.	• "Goal," "objectives," and "outcomes" are sometimes used interchangeably but usually refer to different parts of an assessment process. • "Outcomes" and "results" are also used interchangeably and differently • "Strategies" and "methods" are likewise used interchangeably and differently
Most processes give incomplete descriptions of the assessment process, where some activities are left to the imagination of the reader, who is often a novice.	Steps are often left out, possibly because they are so obvious to the author or because the author did not intend to provide complete details.
Some processes are overly complex, which will tax the resources of the school. What may look good on paper may be unwieldy in implementation.	We have recently begun to realize that assessment gurus may be trying to design the prefect system instead of a practical system.
Some published processes are too general and do not give enough information on how to execute it.	We now understand why this is done--to give the reader flexibility--but this doesn't help early in the process.
Published processes are unclear as to what is "required" and what is "optional."	Apparently, very little is required, as long as what you do makes sense.

TABLE 15. WHAT SUGGESTIONS DO WE HAVE FOR DEANS?
In addition to the contents in Table 10, here are suggestions for deans: • Form a school-wide committee that meets regularly so that departments can learn from each other and share the workload. • Appoint a chair for this committee from among the senior members of the school, preferably one has the interest in becoming the school's resident expert in outcomes assessment or appoint a member of the dean's office to lead the process. Either method can work, but they work in different ways. • Select committee members carefully. If possible, interview them to get a better read on their attitudes toward outcomes assessment. • Hold department chairs accountable for their departments' assessment process. • Develop a culture where outcomes assessment becomes a part of regular business and that it is not an optional activity. • Bring in experts to explain and talk about assessment with faculty and chairs.

TABLE 16. WHAT SUGGESTIONS DO WE HAVE FOR CHAIRS OF SCHOOL-WIDE COMMITTEES?

- Recruit the assistance of faculty members who possess skills and knowledge that can contribute to your outcomes assessment program.
- Conduct or arrange for skill building workshops.
- Get help from your campus committee that oversees outcomes assessment for regional accreditation.
- Form a steering committee--don't try to do it alone.
- Bring them into the discussions from the start instead of trying to shield them. You'll have to contend with their objectives sometime.
- Negotiate for release time. You need time to think, plan, read, and attend conferences and workshops.
- Get the dean to set deadlines for submission of materials. You can get more responses if the dean requests the materials.
- Encourage faculty to be willing to jump into the assessment process before completely understanding it.
- Help your assessment committee develop a general understanding of assessment, its purpose, and its basic elements, and then develop your own assessment process.
- If you develop your own assessment plan, avoid writing one that is either too general or too specific. One that is too general may be seen as being vague, and one that is too detailed may scare faculty by its workload implications or frustrate them by its complexity.
- Define your terms clearly so that disagreements are based on issues, not on misinterpretations.
- Encourage committee members to attend workshops and conferences that focus on assessment and assessment related activities. This goes double for the chairperson of the committee.
- Encourage faculty members to do a lot of networking on campus and at conferences and make contacts that can be used as resources. Do not try to reinvent the wheel.
- Identify campus resources that you can use. By now, all campuses should have a person in its central administration with responsibilities for outcomes assessment. If there is no campus-wide committee that is responsible for outcomes assessment, suggest the formation of such a committee.
- Encourage your school to find ways to recognize and reward faculty who work on assessment related activities.
- Encourage faculty who work on assessment related activities to disseminate the products of their work by writing papers and making presentations at conferences.
- Obtain samples of documents for similar programs, some of which are available on the Web.
- Form a coordinating committee to help plan meeting agendas.
- Identify faculty members who can gain from writing papers on your assessment process for advancement in rank and ask them to serve on your steering committee.
- Schedule meetings regularly and give committee members have opportunity to talk about assessment.
- Ask committee members for feedback regularly to prevent frustration from building.
- Establish time lines to keep the committee and the faculty on track.
- Keep records of all business meetings and assessment activities so that annual reports and scholarly papers can be written.

TABLE 18. QUESTIONS TO CONSIDER AS YOU DEVELOP YOUR PLAN

- How do you minimize any punitive uses of the results of an outcomes assessment process in order to prevent faculty from refusing to participate actively?
- How can a process be designed so that it will produce maximally useful information per unit of work?
- Should the responsibility for outcomes assessment be equally spread among the faculty or should junior faculty be shielded from some of it?
- Should measurable outcomes be developed out of our more general objectives (top-down), or should they be synthesized from the learning objectives of each course (bottom-up)?
- Should we start with broad faculty discussions, followed by distillation and refinement by a select committee (bottom-up), or should a select committee prepare plans and document which are then disseminated to the faculty for discussion and acceptance (top-down)?

TABLE 19. UNEXPECTED FALLOUT OF PLANNING THIS PRESENTATION

The discussions that we had in putting the program together helped further our understanding of outcomes assessment.

Electronic Portfolios - the Technical Side

Goals/ABET Criterion (Criteria) Addressed

With the emphasis on outcome-based assessment (*see ABET Engineering Criteria 2000: Criterion 3--Program Outcomes and Assessment*), portfolio assessment provides a framework for documenting and evaluating student outcomes. This session will provide participants an overview of the development process of an electronic portfolio system prototyped at Rose-Hulman Institute of Technology. The foci of this presentation are to discuss various issues addressed during the system engineering process, and to illustrate how this system will satisfy the specified objective (facilitating the documentation and evaluation processes of student outcomes).

Presentation Format

This session will consist of a presentation using PowerPoint Slideshow and follow by a question and answer session.

Session Summary

Portfolio assessment is chosen at Rose-Hulman as the primary method to collect evidence of student outcomes, and an electronic-version of the portfolio assessment was prototyped during the winter quarter of AY 1997-98 with 30 students representing the sophomore class.

The first step in building an electronic portfolio system begins with the requirement analysis. We ask ourselves these questions to identify which direction of the system engineering process would go:

A) Who is the audience?
B) What is the context?
C) What is being measured?
D) What constraints are present?
E) What resources are available?
F) What should be included in a portfolio?
G) How should a portfolio be organized?
H) In what capacities will portfolios be utilized?

Recognizing the rapidly evolving technology, a conscious decision has been made to apply open systems principles throughout the system engineering process. In an attempt to avoid major redesign of the system in the future, modular design/rapid prototyping approach helps to ensure the system can be quickly built, and yet supported with changing products and technologies. Interface management is also critical in supporting technology insertion. The "web-database" interface is selected to help achieving our goal because of its platform-independent feature.

Once these decisions are finalized, the system design and functional analysis will then follow. Each of the three major system components (Input, Output and Process) has been examined carefully to best utilize available resources with given constraints. In general, the input component of the electronic portfolio system covers materials submission, modification of existing information in portfolio option, on-line rating and feedback options (to be implemented), and end-user's preference selection (to be implemented). Searching, extracting and viewing items from portfolios, and generating ad hoc and routine reports (to be implemented) are within the output component. The process component is the "brain" of the system which controls

security handling of the portfolios, keeps track of versions and defines relationship between the identified objectives and submitted materials, logs transaction activities, joins student background information from campus legacy system (to be implemented), runs queries and posts search results.

Addressing the needs identified during the requirement analysis stage, the result of the system engineering process produces a student-centered, organized, easy-to-learn, easy-to-use electronic portfolio system.

Key Words
Electronic Portfolios, Interface Management, Open Systems Principles, Rapid-prototyping, Requirement Analysis, Student-Centered, System Components, System Engineering Process.

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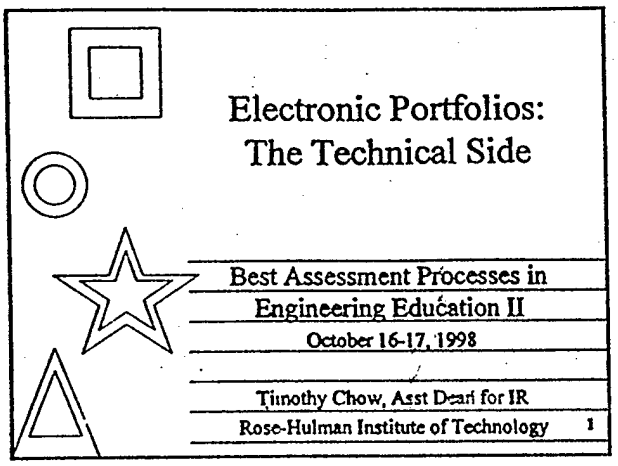
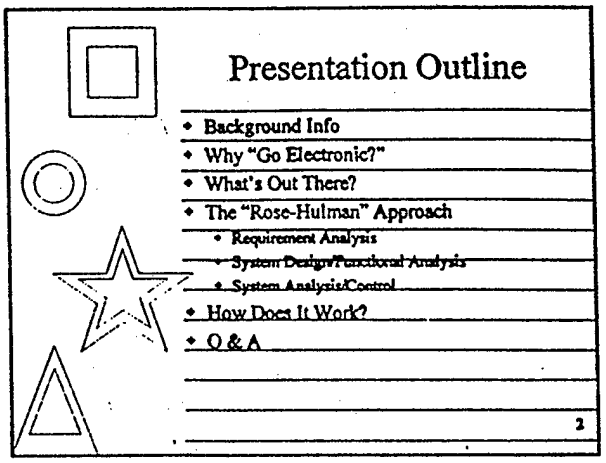
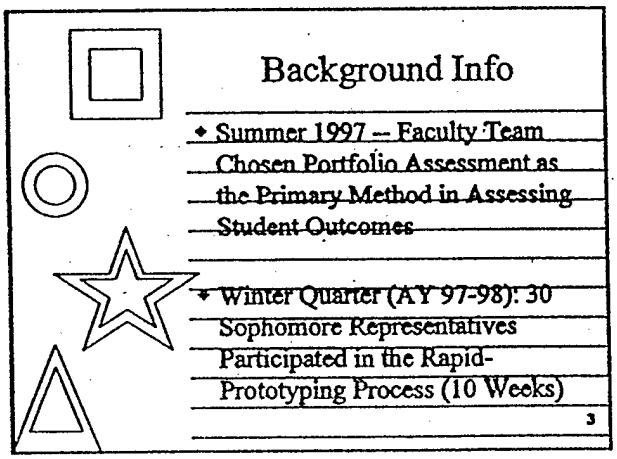
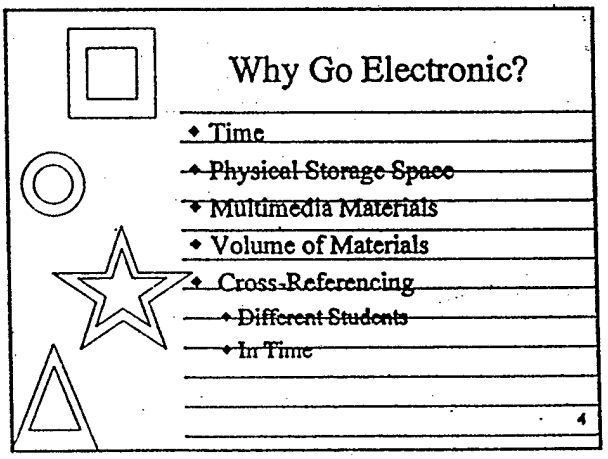
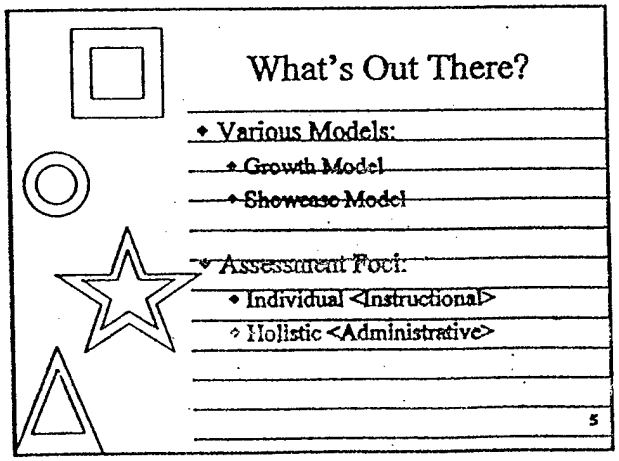
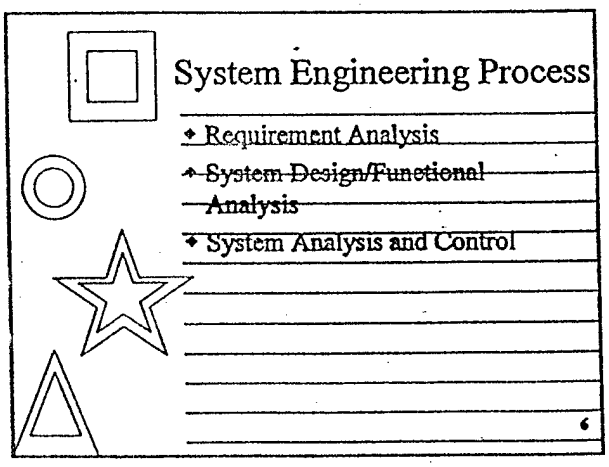

Electronic Portfolios:
The Technical Side
Best Assessment Processes in Engineering Education II
October 16-17, 1998
Timothy Chow, Asst Dean for IR
Rose-Hulman Institute of Technology
1


Presentation Outline
Background Info
Why "Go Electronic?"
What's Out There?
The "Rose-Hulman" Approach
Requirement Analysis
System Design/Functional Analysis
System Analysis/Control
How Does It Work?
Q & A
2


Background Info
Summer 1997 -- Faculty Team Chosen Portfolio Assessment as the Primary Method in Assessing Student Outcomes
Winter Quarter (AY 97-98): 30 Sophomore Representatives Participated in the Rapid-Prototyping Process (10 Weeks)
3


Why Go Electronic?
Time
Physical Storage Space
Multimedia Materials
Volume of Materials
Cross-Referencing
Different Students
In Time
4


What's Out There?
Various Models:
Growth Model
Showcase Model
Assessment Foci:
Individual <Instructional>
Holistic <Administrative>
5


System Engineering Process
Requirement Analysis
System Design/Functional Analysis
System Analysis and Control
6

Requirement Analysis

- Who is the audience?
- What is the context?
- What is being measured?
- What constraints are present?
- What resources are available?
- What should be included in a portfolio?
- How should a portfolio be organized?
- In what capacities will portfolios be utilized?

7

Who is the audience?

- Students
- Faculty (Evaluators)
- Internal Assessment Groups (CASO, IRA)
- potential: Advisors, Employers, Parents, and Accrediting Agencies, etc.

8

What is the context?

- Since it's being utilized for Institute-wide assessment effort, holistic approach to assess student portfolios is chosen.
- A hybrid model is designed with the "Showcase" model as the primary focus (while some of the "Growth" model features will also be available).

9

What is being measured?

- Institute-wide student outcome goals
- Also address requirements from external constituencies: ABET/NCA.

10

What constraints are present?

- Time (Faculty, Student, Staff, Timelines imposed by external constituencies)
- Cost (limited)
- People (limited)

11

What resources are available?

- Hardware (Unix Workstation, "Laptops+Network Infrastructure, " etc.)
- Software (Relational Database Server, Secured Web Server, etc.)
- People (CASO members, 1 P-T system analyst and 1 P-T developer)
- Funding (External Grant, Institute Support)

12

What should be included in a portfolio?

- Based on Rubrics defined, materials derived from course-related and/or co-curricular activities are requested.
- In addition, students are requested to provide reflective statements on each submitted "Best Work."

13

How should a portfolio be organized?

- Minimal structural and content requirements
- ex: Brief Description, Date of Completion, Student Reflection on the entry, etc.

14

In what capacities will portfolios be utilized?

- Initially: Students, Faculty Evaluators, Assessment Groups (document achievements)
- Next Phase: Academic Advisors (link to advising tools/D-Resume)
- Potential: Parents, Employers, Graduate School Admissions Officers, Accreditation Agencies, and Other Constituencies

15

System Design /Functional Analysis

- Define architecture of data model (Open Systems Principles)
- Modular design/Rapid-prototyping
- Interface: Client/Server, Web-Database (Dynamic vs. Static)

16

System Component: INPUT

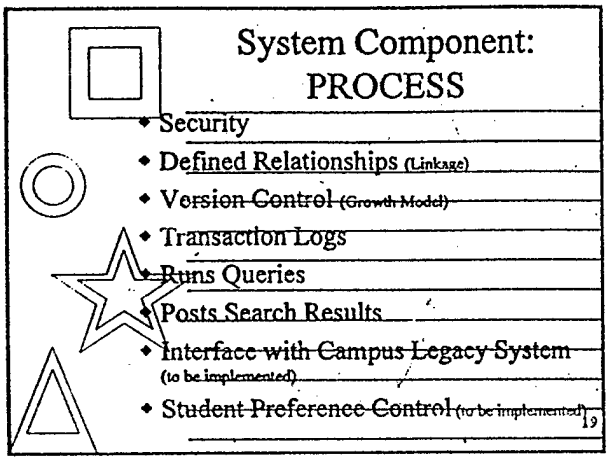
- Materials Submission
- Modification of Archive Materials
- Online Rating/Feedback
- Student Preference Selection

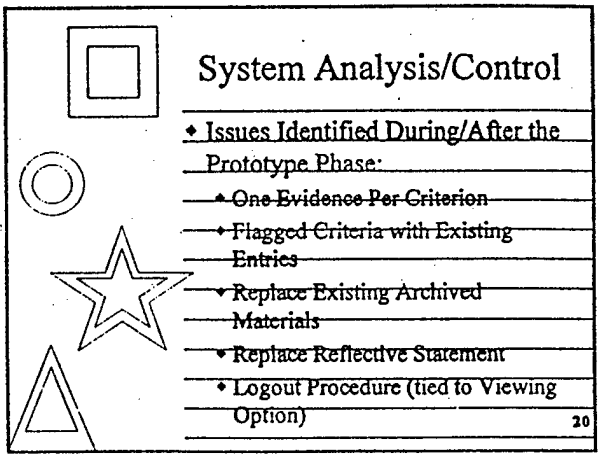
17

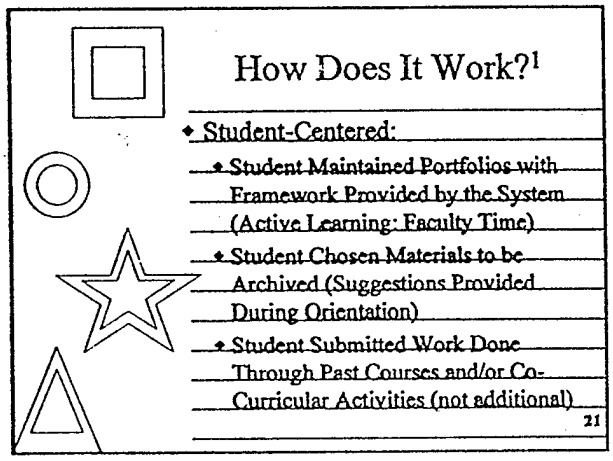
System Component: OUTPUT

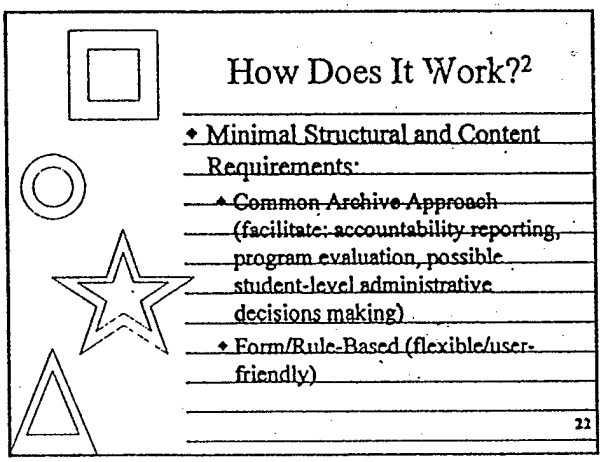
- Searching, Extracting, and Viewing Archived Materials
- Generating Ad Hoc/Routine Reports (to be implemented)

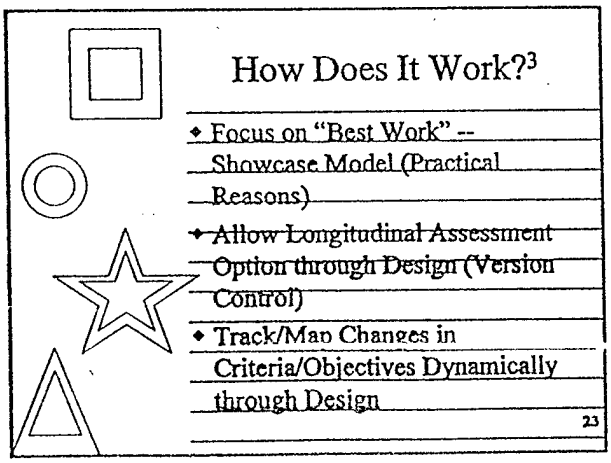
18

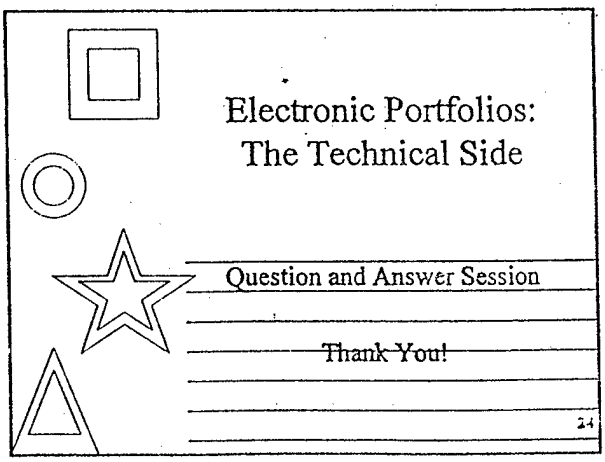

System Component: PROCESS
Security
Defined Relationships (Linkage)
Version Control (Growth Model)
Transaction Logs
Runs Queries
Posts Search Results
Interface with Campus Legacy System (to be implemented)
Student Preference Control (to be implemented)
19


System Analysis/Control
Issues Identified During/After the Prototype Phase:
One Evidence Per Criterion
Flagged Criteria with Existing Entries
Replace Existing Archived Materials
Replace Reflective Statement
Logout Procedure (tied to Viewing Option)
20


How Does It Work?1
Student-Centered:
Student Maintained Portfolios with Framework Provided by the System (Active Learning: Faculty Time)
Student Chosen Materials to be Archived (Suggestions Provided During Orientation)
Student Submitted Work Done Through Past Courses and/or Co-Curricular Activities (not additional)
21


How Does It Work?2
Minimal Structural and Content Requirements:
Common Archive Approach (facilitate: accountability reporting, program evaluation, possible student-level administrative decisions making)
Form/Rule-Based (flexible/user-friendly)
22


How Does It Work?3
Focus on "Best Work" -- Showcase Model (Practical Reasons)
Allow Longitudinal Assessment Option through Design (Version Control)
Track/Map Changes in Criteria/Objectives Dynamically through Design
23


Electronic Portfolios: The Technical Side
Question and Answer Session
Thank You!
24

Learner-Centered Web-Based Assessment Tool for Large and Small Classes

Goals/ABET Criteria Addressed

The classroom assessment technique, which is a part of every class period, can be a key component of a broader assessment plan satisfying Criteria 1-3 of the EC 2000.

Presentation Format

Interactive, video clips, demonstration via the Internet (if possible).

Session Summary

The primary purpose of classroom assessment is to determine how well students are learning on a continuous basis and to take necessary corrective action as soon as possible to improve their learning. This presentation will describe a computerized web-based assessment technique that can be used effectively and easily in large and small classes. The technique allows instructors and students to monitor the learning process on a daily basis and to quickly point out the need for corrective action, if necessary. Students can view their performance and also the average class performance on the web. The graphical displays allow them to see the trend of their performance over several days. Several reports, automatically generated for instructors, allow them to determine promptly how well certain concepts or topics are learned by students. Use of special codes and optical scanning sheets minimize paper shuffling in large classes, and the computer program automatically grades and updates the database. The program is fairly general and has friendly interfaces; thus it can be implemented for use by faculty at other universities. According to student response sheets, 80 to 97 percent of the students find different aspects of the technique to be effective in improving learning.

Key Words

Classroom assessment, web-based assessment, daily homework, reading quizzes, attention quizzes, prompt feedback, large classes

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Session Presenters

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Outline of an Interactive Presentation

1. What is classroom assessment?

2. How is it related to ABET's EC 2000?

3. What is the importance of prompt feedback?

4. How to handle daily homework, especially in large classes?

5. What, Why, and How to conduct Reading Quizzes?

6. What, Why, and How to conduct Attention Quizzes?

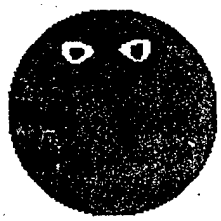
7. How DHQM can help in small or large classes?

8. Would you like to see a short video on DHQM in action?

9. What are the results of the DHQM?

10. Is DHQM available to other schools?

11. Would you like to see a demonstration of the DHQM?



DHQM

Daily Homework/Quiz Manager

Welcome to the Daily Homework/Quiz Management home page. Please follow one of the following links:

- Grade Information (<-- Click here if you are a student!)
- Instructor Pages
  - Register as an instructor for DHQM here!
- To preview the Instructor Pages, click on the "Instructor Pages" link and enter in 'test' for both the Username and Password.

- About the DHQM Package

Figure 1 The first Screen of the DHQM

(You can test the package by going to http://valley.nodak.edu/dhqm/)

DHQM - Class Management

- Process new OMR files [Help]
- Daily Summary (for a particular day) [Help]
- Multi-Day Summary [Help]

- Add a student to your class [Help]
- Delete a student from your class [Help]
- Change a student's grade [Help]

- Add a new class [Help]
- Delete a class [Help]

- Delete the data for a particular day (95%) [Help]
- Download Class Database (Excell/Tab Delim.) [Help]

Back to the Main DHQM page

About the DHQM Package

Figure 2 Features available on the Instructor's Page

DHQM Daily Summary

Class: me221

Select the date that you wish to view:

August 29, 1997
September 3, 1997
September 5, 1997
September 8, 1997
September 12, 1997
September 15, 1997
September 17, 1997

Continue | Change Class

Summary for December 3, 1997

Homework question: 1

Min:	Mean:	Max:	Standard Deviation:
0	9.852	10	0.930

Frequency Distribution

Score:	Number of scores:	
0	1 / 142	
6	1 / 142	
8	1 / 142	
9	5 / 142	
10	134 / 142	

Quiz question: 2

Min:	Mean:	Max:	Standard Deviation:
0	0.915	1	0.279

Frequency Distribution

Score:	Number of scores:	
0	12 / 142	
1	130 / 142	

Figure 3 A Part of Instructor's Daily Report Showing Statistics for Homework and Quiz

DHQM - Student Grades

Overall Grade

DHQM	Homework	Quiz
Your Total Grade:	428 / 570 (75%)	32 / 61 (52%)
Class Total Average:	554.2 / 570 97.23 %	49.8 / 61 81.66 %

Daily Grades

Class Date	DHQM	Homework	Quiz
November 25, 1996 124 students	Your Score:	20 / 20 (100%)	0 / 1 (0%)
	Class Average:	19.624 (98.12%)	0.704 (70.40%)
December 2, 1996 119 students	Your Score:	20 / 20 (100%)	2 / 2 (100%)
	Class Average:	19.883 (99.41%)	1.800 (90.00%)
December 4, 1996 121 students	Your Score:	20 / 20 (100%)	1 / 2 (50%)
	Class Average:	19.467 (97.33%)	1.615 (80.75%)

Back to the Main DHQM page
Back to the Student Login page

About the DHQM Package

Figure 4 Feedback to Students about their Daily and Overall Performance

PROCESS FOR CURRICULUM ASSESSMENT IN MECHANICAL ENGINEERING AT THE UNIVERSITY OF WISCONSIN

Goals/ABET Criterion Addressed

The goal of the session is to aid faculty in developing a plan and carrying out the assessment of a program in support of both ABET visits and curriculum development.

Presentation Format

The format will be presentation in segments with time for questions and answers.

Session Summary

The experience gained in involving faculty at a large research-oriented department in the assessment of student education will provide the basis of the discussion. Faculty interest in the assessment process is crucial, and at UW the faculty had already made an implied commitment through their involvement in several learning and teaching programs. A departmental Assessment Committee was then able to build on this commitment. At retreats and faculty meetings this committee lead the process by which the assessment objectives were defined. The LEAD Center, which is an evaluation center on campus, took the Department objectives, modified them to yield useful results, and carried out the actual assessment. The experience with the process of generating the assessment tools with the entire faculty involved and the results of the assessment will be the subject of the workshop.

Key Words

Assessment, Evaluation, Exit Interviews, Alumni Surveys

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Session Presenters

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Who is the Mechanical Engineering Department?

- Department of 35 faculty members in three areas (Energy, Design, Manufacturing)
- Between 150 and 175 students graduated each year with a BS degree
- 220 graduate students at the MS and PhD level, most supported on research funds

How did the assessment process initiate?

- Assessment of curriculum initiated in 1995 based on the Department's Strategic Plan
- Process began with small groups of faculty in meetings and retreats
- Faculty developed a set of educational objectives for curriculum
- Initially, a set of Knowledge and Skill goals for students to master by graduation
- Finally, a set of detailed and specific questions relating to mastery of material
- During this process
  - Faculty knew what they wanted to assess but were unsure of how to do it
  - Faculty developed methods of assessment that would be difficult to implement
  - Departmental resources became a limiting factor in conducting the assessment
  - Faculty were interested in assessment but attention was limited to about 2 hours
- Faculty had demonstrated a commitment to learning and teaching programs:
  - Faculty Teaching Improvement Program
  - Weighting of teaching performance in merit raises
  - Development of a teaching evaluation form

How was the assessment actually carried out?

- The faculty as a whole defined the objectives and issues of interest
- LEAD Center and a small faculty committee converted these into a useable tool
  - Not appropriate for faculty to conduct student interviews
  - Interview questions could not address technical achievements
  - Conventional classroom testing was appropriate to assess knowledge and skills
  - Necessary external funding was provided by the UW Assessment Council
- Interviewed 25 graduating seniors in class of 1997 (about 15 % of graduating class)
  - Questionnaire on quantitative aspects
  - Interview on qualitative aspects
- Sent surveys to the 157 students of the class of 1994
  - Covered both qualitative and quantitative aspects of program
  - Sixty surveys returned (38 % of class)

What have been the results of the assessment process?

- Curriculum improvements in response to student consensus
  - Advising system
  - Instrumentation laboratory course
  - Curriculum integration
  - Time to graduate and number of credits
- Continued improvement of assessment process for class of 1998

What is LEAD? (Learning through Evaluation, Adaptation, & Dissemination)

- Founded in 1994 at the UW-Madison by Dr. Susan Millar
- Research center of professional evaluators trained in anthropology, psychology, education, mathematics, etc.
- Provides evaluation research support for educational reform efforts at both the undergraduate and graduate levels and in support of university outreach activities
- Projects include course-level evaluations, program (i.e., department or major) assessments, and institutional evaluations
- Funding for LEAD projects is through grants provided by clients (these grants may be secured through partnerships with LEAD researchers)

What's so important about "third-party" evaluation?

- Students and alumni are more likely to share information with external evaluators that they might be hesitant to provide directly to the department
- Well-chosen external evaluators come to the project with enough context to make sense of the findings, but without the preconceptions of department members
- Trained evaluators can provide expertise and experience in conducting quantitative and/or qualitative research, and are familiar with relevant literature, research, and resources

What did LEAD do for Mechanical Engineering?

- Objectives and issues of interest were defined by ME faculty
- LEAD researchers shaped these objectives and issues into effective survey and interview questions
- LEAD researchers maintained anonymity of students and alumni by serving as conduit for information
- LEAD researchers analyzed the information and found central themes:
    - *speech training available only in on-campus communications class*
    - *laboratory too rigorous to allow digestion of material*
    - *advising frequently unused because of department "flow-chart"*
    - *computer skills learned, of necessity*
    - *"independent learning" was an implicit theme in the interviews and surveys*

What can a department do without a LEAD Center?

- Build a rapport with your students (and thus your alums). If they know you want and will use the information they provide, they are more likely to help out, even when you don't explicitly ask. One way to do this is to share what you find in your assessments and share what you are doing with those results.
- Test your survey or interview questions on a colleague or a few students to be sure the questions are clear and will elicit the information you need.
- Allow students to respond anonymously or via a non-faculty member.
- Read between the lines: look for patterns in what students are saying and look for connections across questions.
- Don't reinvent the wheel: borrow from what colleagues have done, get recommendations on useful and relevant literature (see the bibliography provided above).

DEPARTMENT of MECHANICAL ENGINEERING ASSESSMENT
PRE-INTERVIEW SURVEY – GRADUATING SENIORS

1. Name _____

2. How many semesters has it taken you to reach graduation (incl. co-op)? _____

3. How many credits has it taken you to reach graduation? _____

4. Have you been a full-time student?
   - O *Yes, throughout school.*
   - O *No, I've always been part-time.*
   - O *Sometimes full-time, sometimes part-time.*

5. Which of the following describe(s) your work experience during the past year? Check all that apply.
   - O *I've been working approximately _____ hours per week **during the semester.***
   - O *I've been working approximately _____ hours per week **during the summer.***
   - O *I have completed one or more co-ops. (How many?_____)*
   - O *I have completed one or more internships. (How many? _____)*
   - O *I have work experience related to engineering. Which field(s)? _____*
   - O *I have not been working while attending school.*

6. What are your post-graduation plans? (If you are planning on both employment and graduate school, please indicate which you plan to do first.)
   - O *Employment in (what field?)* _____
   - O *Graduate school in (what field?)* _____
   - O *Undecided*

7. Have you had a job offer? O *Yes* O *No* O *Not sure*
   What type of company(ies) are you interviewing with? Check all that apply.
   - O *Consulting* O *Sales & Service* O *Manufacturing*
   - O *Design* O *Research & Development* O *Other* _____

8. Where would you like to work after graduation?
   - O *Specific city, state, region, or country (specify here)* _____
   - O *Anywhere I can get the best job.*
   - O *Undecided.*

9. Have you taken or do you plan to take the FE exam? O *Yes* O *No* O *Not sure*

10. Approximately how many hours per week do you spend on coursework outside of class for each of the following types of courses? Please estimate the time required for one (1) class under each category.

	0-5 hrs/wk	*5-10 hrs/wk*	*10-15 hrs/wk*	*15-20 hrs/wk*	*>20 hrs/wk*
Math & Science Courses					
ME Core Courses					
ME Electives					
Computer Science Courses					
Tech. Comm. Courses					
Liberal Studies Courses					
Co-op					

DEPARTMENT of MECHANICAL ENGINEERING ASSESSMENT INTERVIEW QUESTIONS – GRADUATING SENIORS

Note to Interviewers: Begin by reviewing the survey form for topics to pursue. It is not necessary to ask <u>all</u> of the questions that follow, nor to ask them in precisely the wording provided. <u>Do</u> be sure to follow up on all answers that require explanation (i.e., ask "Why?" frequently).

QUESTIONS ABOUT THE PROGRAM OVERALL

1. How do you feel about your choice of major now that you're about to graduate?
2. What did you expect of the ME program when you began your major?
3. What do you think about the integration of the program? In other words, do you see how your various courses fit together? Does it seem like a "program" or merely a "sequence of courses"?
4. What do you think about the current structure of the program? (Including the number and types of courses, electives vs. requirements, etc.)
5. [Refer to survey page:] If you have taken more than 120 credits, why did you take more than the required number? If you have taken just 120, what helped you to finish without additional credits? (Advising, cafeteria-style course sampling, change majors, double major?)
6. What, if any, changes in your undergrad program would have helped better prepare you for work as an ME?
7. Do you think the ME program has equipped you for a typical day on the job? What do you think a typical day would be like? What did you learn in your undergrad program that will assist you in your 1st job?
8. Are there areas of your undergraduate program that you feel will not be useful to you? What are they?

QUESTIONS ABOUT TECHNICAL, DESIGN, AND MANUFACTURING SKILLS

1. Do you feel adequately prepared to analyze a mechanical engineering problem? Why or why not?
2. Do you feel adequately prepared to conduct experiments? Why or why not?

3. Do you feel confident about your computer skills? Why or why not?
4. Given your coursework in manufacturing, do you feel adequately prepared to enter manufacturing (even if you don't plan to do so)? Why or why not?
5. To what extent did the senior design course prepare you for work as a mechanical engineer? Which aspects of the course were most and least useful in preparing you for this work?
6. If you completed a co-op, did you find it valuable? Why or why not?

QUESTIONS ABOUT NON-TECHNICAL SKILLS

1. Do you think you've gained the skills necessary to be an effective team member on the job? What are those skills? Was there a particular area of the ME program that helped you gain those skills?
2. Do you think you've gained the skills necessary to communicate effectively (orally and in writing) on the job? Which parts of the ME program helped you gain those skills?
3. Are there any other non-technical skills that you think you'll need on the job? What are they? How well has the program helped you gain those skills?

QUESTIONS ABOUT TEACHING AND LEARNING STYLES

1. I'd like you to think about how you learned in your last two years in the program (lecture, homework, in a group, alone, hands-on, by applying what you learned to real life). Overall, what were the best ways for you to learn? What helped you make connections with the material? Can you describe an example of an assignment or project that you found especially effective in helping you learn?
2. Given that no undergraduate program can teach you everything you'll ever need to know as a mechanical engineer, do you feel prepared to learn on your own after graduation?
3. Where have you received the most useful curricular and career advice and information? What types of information have been most useful for you?

WRAP-UP QUESTION

1. Any other comments on the program or "messages" you'd like the faculty to hear?

DEPARTMENT of MECHANICAL ENGINEERING ASSESSMENT
ALUMNI SURVEY – EXCERPT

Career Preparation:
Please rate how well your ME undergraduate education at UW-Madison prepared you for the following activities and also rate how frequently you engage in these activities.

	Level of Preparation			Frequency of Use				
	Strong	Adequate	Weak	Daily	Weekly	Monthly	Yearly	Never
Analyze mechanical engineering problems								
Design & conduct experiments								
Use computers/software								
Work in manufacturing								
Work in design								
Work on a multi-disciplinary team								
Communicate orally								
Communicate in writing								
Make technical decisions								
Make ethical decisions								
Make business decisions								
Manage projects								
Manage people								
Consider the societal or global impact of my work.								
Teach myself new things								

Overall, how well prepared do you believe you are to compete within your field or current area of employment?

O *Very Prepared* O *Somewhat Prepared* O *Somewhat Unprepared* O *Very Unprepared*

For areas in which you feel your preparation was strong, what aspects of the ME program gave you that preparation?

For areas in which you feel your preparation was weak, what aspects of the ME program could be improved to give that preparation?

Were there any areas of the ME undergraduate program that you felt were unnecessary? If so, please identify them and explain why they seemed superfluous.